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INSTRUCTION MANUAL

MODEL 601-19-0-F1338
RMU EMULATOR
(POA F1338)

SANGAMO WESTON
Schlumberger

MP MASTER
MA20089

INSTRUCTION MANUAL

MODEL 601-19-0-F1338
RMU EMULATOR
(POA F1338)

SANGAMO WESTON
Schlumberger

P. O. 3041 • SARASOTA, FLORIDA 33578 USA • TEL: 813-371-0811 • TELEX: 052-890 • TWX: 810-864-0406

APRIL 1981

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	Model 640 Dual Channel Voltage-Controlled Oscillator	
	Model 645-02, -03, -04 Reference Oscillator/VCO/Dual Mixer Amplifier	

SECTION 1

GENERAL DESCRIPTION

1.0 INTRODUCTION

The Model 601-19-0-F1338 RMU (Remote Multiplex Unit) Emulator was built for Boeing Engineering Construction Company, Seattle Washington by Sangamo Weston, Inc. Data Systems Division, Sarasota, Florida, under DSD POA F1338.

This technical manual comprises three sections, listed as follows:

Section 1 General Description
Section 2 Model 601 System Equipment Case
Section 3 600 Series Printed Wiring Assemblies

The Model 601-19-0-F1338 RMU Emulator accepts up to 16 high level data input signals, generates 16 FM subcarrier channels and a reference FM channel and combines the seventeen signals in to an FM multiplexed baseband for user application.

2.0 PHYSICAL DESCRIPTION

The Model 601-19-0-F1338 RMU Emulator (refer to Drawing 43786 at the end of this section) consists of a Model 601 System Equipment Case that is designed to house eight Model 640 Dual Channel Voltage Controlled Oscillator Printed Wiring Assembly and a Model 645 Reference Oscillator PWA. Provision is made for optionally installing a Model 649 Voltage Calibrator PWA.

The Equipment Case is a special design, in that it has a non-standard rear panel assembly. Special mating connectors are installed to provide for signal input of sixteen data channels, output of multiplexed data, calibration voltage input, and power input. Also three spare connectors are mounted on the rear panel.

The input ac power, 115 Vac single-phase, is routed to two power supplies, PS1 and PS2. PS1 outputs $\pm$15 Vdc and PS2 outputs +12 Vdc.

The printed wiring assemblies supplied with the Model 601-19-0-F1338 are listed as follows:

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https://archive.org/details/manualsplus_07229

Description	Qty
Model 640-02-1.000-0.125 kHz-1.500-0.125 kHz Dual Channel VCO PWA	1
Model 640-02-2.000-0.125 kHz-2.500-0.125 kHz Dual Channel VCO PWA	1
Model 640-02-3.000-0.125 kHz-3.500-0.125 kHz Dual Channel VCO PWA	1
Model 640-02-4.000-0.125 kHz-4.500-0.125 kHz Dual Channel VCO PWA	1
Model 640-02-5.000-0.125 kHz-5.500-0.125 kHz Dual Channel VCO PWA	1
Model 640-02-6.000-0.125 kHz-6.500-0.125 kHz Dual Channel VCO PWA	1
Model 640-02-7.000-0.125 kHz-7.500-0.125 kHz Dual Channel VCO PWA	1
Model 640-02-8.000-0.125 kHz-8.500-0.125 kHz Dual Channel VCO PWA	1
Model 645-02-9.500-0 Reference Oscillator/Dual Mixer Amplifier	1

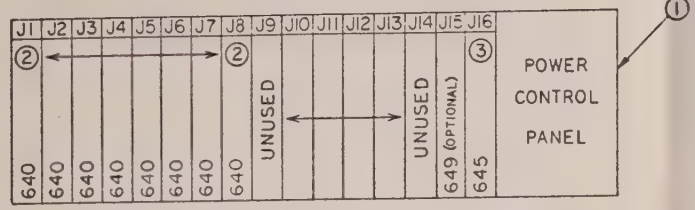
3.0 FUNCTIONAL DESCRIPTION

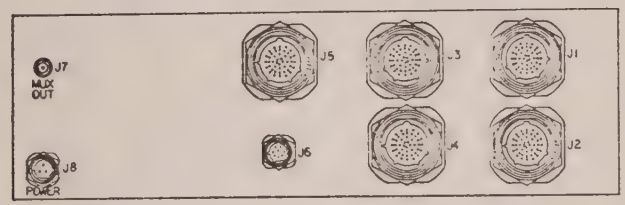
Functionally, the Model 601-19-0-F1338 accepts 16 data signal channels that are routed to eight dual channel VCO. Each VCO channel produces an FM subcarrier frequency output. The frequency range of the 16 FM subcarrier channels is from 1.000 kHz to 8.500 kHz. In addition, a reference channel VCO provides as FM subcarrier of 9.500 kHz. The reference channel VCO provides a stable, low-distortion reference signal for use in systems requiring tape speed compensation.

These seventeen FM subcarrier frequency channels are combined into an FM multiplex baseband by a mixer amplifier, and the FM multiplex baseband is routed to an output connector that is mounted on the rear panel.

HOLE/COMPONENT CHART

HOLE	QTY	DESCRIPTION/UNUSED NUMBER
J1	640	
J2	640	
J3	640	
J4	640	
J5	640	
J6	640	
J7	640	
J8	640	
J9		UNUSED
J10		
J11		
J12		
J13		
J14		UNUSED
J15	649	(OPTIONAL)
J16	645	





CONNECTOR	TYPE	FUNCTION
A3J1-A3J2	MS3124E22-55P	CHANNEL INPUTS
A3J3-A3J5	"	SPARES
A3J6	MS3124E12-8P	CALIBRATE COMM
A3J7	UG-1094	MULTIPLEX OUT
A3J8	MS3124E12-3P	PRIMARY PWR IN

REAR PANEL CONNECTOR FUNCTION TABLE FOR MODEL 601-19-0-F1338

REAR PANEL INPUT CONNECTOR PIN ASSIGN. CH.

A3J1		A3J2	
PIN LTR	SIGNAL	PIN LTR	SIGNAL
A	+DATA CH 1	A	+DATA CH 9
B	SHIELD CH 1	B	SHIELD CH 9
C	-DATA CH 1	C	-DATA CH 9
D	+DATA CH 2	D	+DATA CH 10
E	SHIELD CH 2	E	SHIELD CH 10
F	-DATA CH 2	F	-DATA CH 10
G	+DATA CH 3	G	+DATA CH 11
H	SHIELD CH 3	H	SHIELD CH 11
J	-DATA CH 3	J	-DATA CH 11
M	+DATA CH 4	M	+DATA CH 12
L	SHIELD CH 4	L	SHIELD CH 12
K	-DATA CH 4	K	-DATA CH 12
R	+DATA CH 5	R	+DATA CH 13
P	SHIELD CH 5	P	SHIELD CH 13
N	-DATA CH 5	N	-DATA CH 13
U	+DATA CH 6	U	+DATA CH 14
T	SHIELD CH 6	T	SHIELD CH 14
S	-DATA CH 6	S	-DATA CH 14
AA	+DATA CH 7	AA	+DATA CH 15
BB	SHIELD CH 7	BB	SHIELD CH 15
9	-DATA CH 7	9	-DATA CH 15
FF	+DATA CH 8	FF	+DATA CH 16
EE	SHIELD CH 8	EE	SHIELD CH 16
DD	+DATA CH 8	DD	-DATA CH 16

ARTWORK REVISION INDEX

SHEET NO						
REVISION						

REVISIONS

SYM	DESCRIPTION	EFFECTIVITY	DATE	APPROVED

	1	905-13-00630	43787	WIRING DIAGRAM	REF
	1	205-89-01680	29929	645-02-9.500 PWA REF OSC/DUAL MIXER AMP	3
	8	205-89-01052	19371	640-02 PWA DUAL CHANNEL VCO	2
	1	C23-89-00084	30099-2	CABINET ASSEMBLY	1
-1	BASIC	CONTROL NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	ITEM OR NUMBER

CONFIGURATION

STY RECORD

PARTS LIST

UNLESS OTHERWISE SPECIFIED

DRAWN E J HARBERT 1-25-91

ENGR

APPVD

PROJ ENGR

PROD ENGR 1-25-91

MATERIAL

TREATMENT OR FINISH

APPVD

APPLICATION

DO NOT APPLY PART NO. IDENTIFY PER EMP 1340E

LOCATE APPROX AS SHOWN

BENDIX/KING

RMU EMULATOR ASSEMBLY

MODEL 601-19-0-F1338

ESS	FINAL	F1338
DRAWING NO	NEXT ASSY NO	USED ON

SIZE	CODE IDENT NO	DRAWING NO	REV
D	06141	43786	

SCALE — | 179-89-00000 | SHEET 1 OF 1

PROTOTYPE CONTROL | LIMITED CONTROL | STANDARD CON TROL | GRADE | CATEGORY | S W . AR . 92

LIMITED CHANGE

REQUESTED BY: ENGINEERING PARTS LIST CODE IDENT 06141

PARENT ITEM NUMBER	ITEM DESCRIPTION	I T	I C	I S	UM	ENG REV	ECO NUMBER	DS	S Z	MFG NAME	MFG PART
179-89-00020	RMU,EMULATOR ASSY MOD 601-19	1	K	2	EA	**	0		D	EMR	43786

FIND NO	COMPONENT ITEM NUMBER	ITEM DESCRIPTION	O T	QUANTITY	UM	C T	MFG NAME	MFG PART
006	191-89-00661	PANEL,ASSY,PWR CONTROL	1	1	EA	1	EMR	23164-1
PS001	202-98-00023	PWR SPLY,DUAL,+&-15V@.7A	1	1	EA	1	MML59	SPS30D-12/15
PS002	202-98-00027	PWR SPLY 12V@1.8A,115/230	1	1	EA	1	MML59	SPS30-12

SECTION 2

MODEL 601 SYSTEM EQUIPMENT CASE

NOTE

Figure 4, Drawing 43785, replaces Figure 4, Drawing 24601.
Table 3, PL-43785, replaces Table 3, PL-24601-2

MODEL 601 SYSTEM EQUIPMENT CASE

1.0 GENERAL

This section contains information describing the EMR 601 Equipment Case. This case provides mounting and wiring facilities for EMR 600-Series Industrial Telemetry Cards (printed-wiring assemblies). Detailed information describing the individual cards in the system is contained in separate sections of this manual.

2.0 PHYSICAL DESCRIPTION

The 601 case is available in two sizes (Models 601-1 and 601-5) to facilitate 5 and 16 EMR 600-Series cards. These cases may be configured to suit individual customer requirements for portable or rack mounting. Mounting cards are provided with all 16-card units. The rack-mount version is designed for use in an EIA-type rack and occupies 5-1/4 inches of panel height. Figure 1 illustrates dimensions of the 601-1 case. Figure 2 illustrates dimensions of the 601-5 case.

The 601 is supplied with an integral power supply, front access power switch and fuse holder. The front panel is hinged for front access to printed-circuit cards and is provided with a magnetic latch. Guides are provided for insertion and removal of printed-circuit cards.

An equipment case assembly drawing and parts list are provided in Figure 1 and Table 1 for the 601-1 and Figure 3 and Table 2 for the 601-5. The rear panel assembly drawing and parts list are Figure 4 and Table 3, respectively. The power control panel assembly diagram and parts list is Figure 5 and Table 4, respectively.

3.0 ELECTRICAL DESCRIPTION

Each equipment case is factory wired to accept a particular group of cards. A complete (power and signal) wiring diagram along with the card location layout is shown in Figure 6.

4.0 SPECIFICATIONS

Dimensions:

-1 (Five Card Slots) - 5 in. high by 10.2 in. wide.
Extends 10 in. behind panel.
-5 (Sixteen Card Slots) - 5-1/4 in. panel space in 19 in.
EIA-type equipment rack.

Weight:

-1 Approximately 14 lb., fully loaded.
-5 Approximately 22 lb., fully loaded.

Mounting:

Six No. 10 screws through base or mounts in EIA-type equipment rack.

Connectors:

Internal Connectors: All 600-Series cards mate with Cinch (251-22-30-160) 22-pin connectors.

Rear-Panel Connectors: 601-1 - Solder connections to internal connectors only. 601-5 - Up to 36 BNC connectors plus 20-terminal Kulka barrier strip.

5.0 ORDERING INFORMATION

a b c d

Specify "Model 601-x-x-x-xxxxx Equipment Case."

a = Number of Card Slots:
1-five card slots
5-sixteen card slots, rack mountable or portable

b = Power Source Voltage:
1-10.5V DC to 14V DC
2-105 to 132V rms, 50 to 60 Hz
3-Special

c = Configuration:
1-Standard
2-Special

d = USED ONLY WHEN SPECIAL CONFIGURATION IS ORDERED:
Specify all required options. POA number will be assigned by EMR upon receipt of order.

For 600 Series cards refer to ordering information included in each particular card section in this manual.

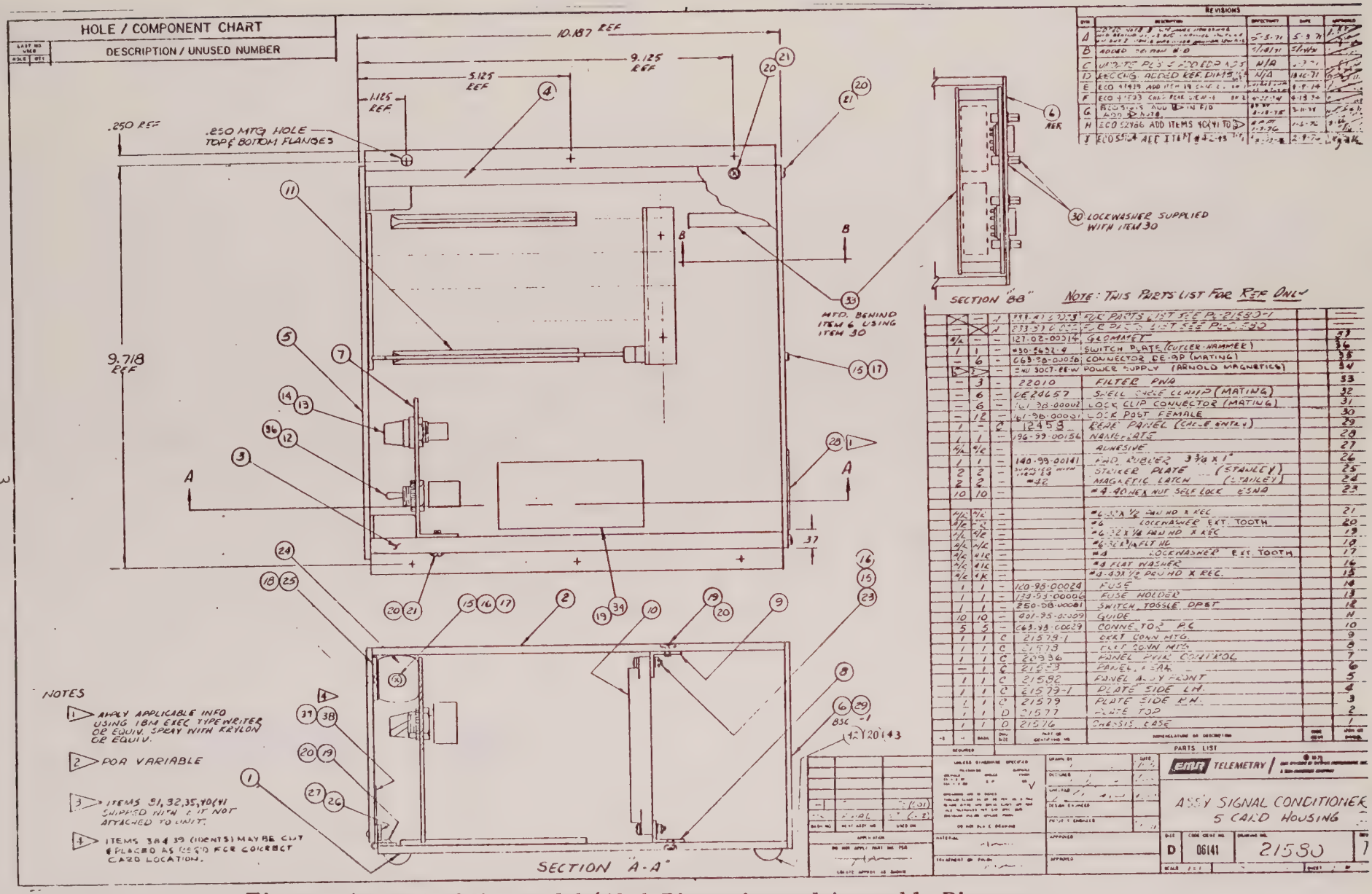

HOLE / COMPONENT CHART
DESCRIPTION / UNUSED NUMBER
10.187 REF
9.125 REF
5.125 REF
1.125 REF
.250 REF
.250 MTG HOLE TOP & BOTTOM FLANGES
9.718 REF
.37
MTD. BEHIND ITEM 6 USING ITEM 30
30 LOCKWASHER SUPPLIED WITH ITEM 30
SECTION "BB"
NOTE: THIS PARTS LIST FOR REF ONLY
SECTION "A-A"
NOTES
1 ANALY APPLICABLE INFO USING IBM EXEC TYPEWRITER OR EQUIV. SPRAY WITH KRYLON OR EQUIV.
2 POR VARIABLE
3 ITEMS 31, 32, 35, 40(4) SHIPPED WITH 2 IF NOT ATTACHED TO UNIT.
4 ITEMS 38 & 39 (IDENTS) MAY BE CUT & PLACED AS REQ'D FOR CORRECT CARD LOCATION.
REVISIONS
PARTS LIST
TELEMETRY
ASSY SIGNAL CONDITIONER 5 CARD HOUSING
D
06141
21580

Figure 1 (sheet 1 of 2). Model 601-1 Dimension and Assembly Diagram.

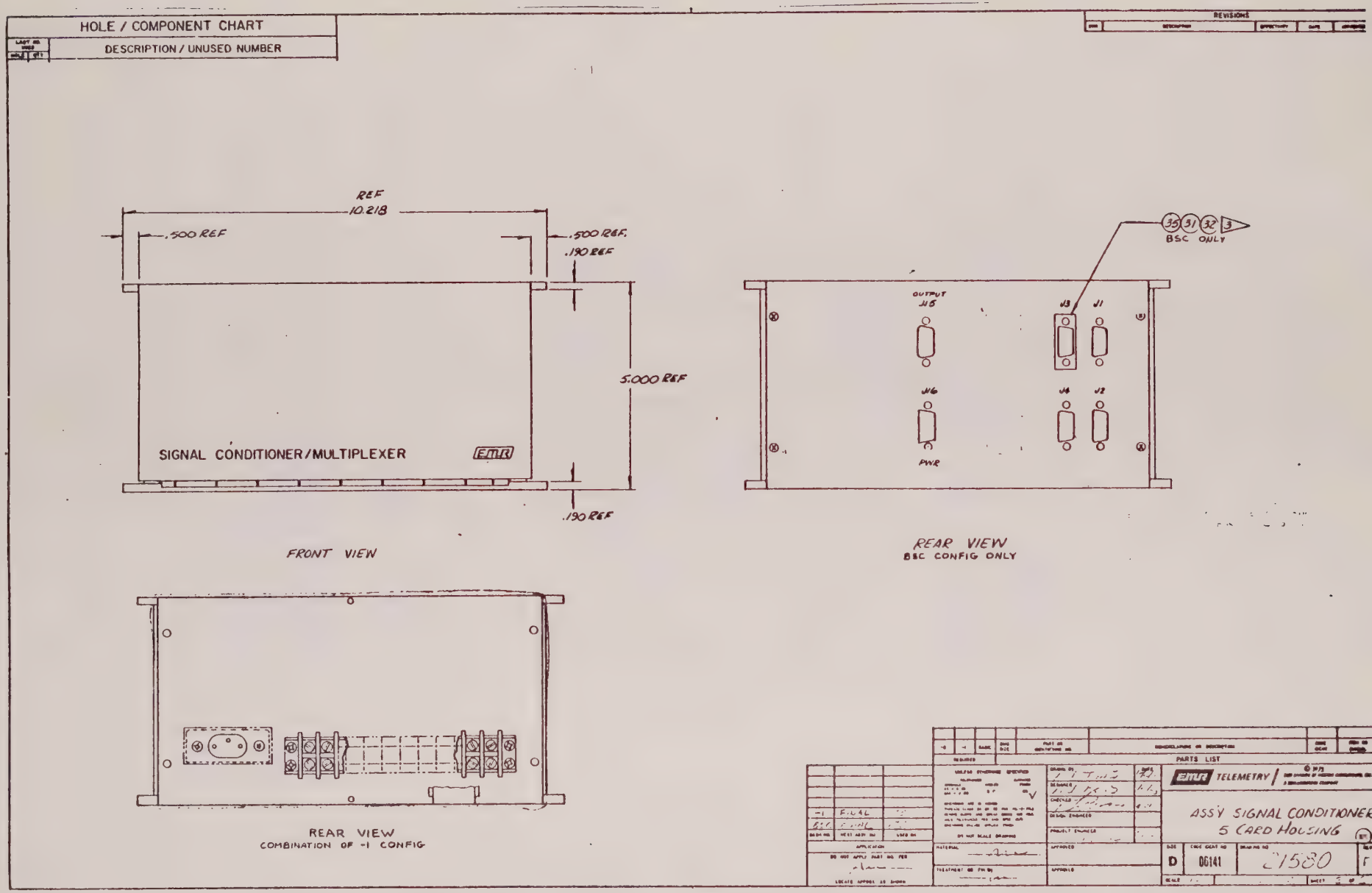


Figure 1 (sheet 2 of 2). Model 601-1 Dimension and Assembly Diagram.

Table 1.

PARTS LIST 21580-1 REV DATE 04/12/76 REV LTR E

LIST TITLE SIGCN,ASSY,MULTIPLEXER CHGE CONT NO. CODE IDENT SHT 1 OF 1
PART NO. 233-89-00023 ECO RECORD 1 06141 CKD BY

ITEM NO.	QTY REQD	E M R NUMBER	DRAWING OR SPEC NO.	DESCRIPTION	VENDOR NAME	VENDOR PART NUMBER	USAGE
1	1	196-99-00193	21576	PLATE,BASE	EMR	196-99-00193	
2	1	196-99-00194	21577	PLATE,TOP	EMR	196-99-00194	
3	1	196-99-00279	30093	PLATE,SIDE,RH	EMR	196-99-00279	
4	1	196-99-00280	30093-1	PLATE,SIDE,LH	EMR	196-99-00280	
5	1	191-89-00438	21582	PANEL,ASSY,FRONT	EMR	191-89-00438	
7	1	191-89-00436	20936	PANEL,ASSY,PWR CONTROL	EMR	191-89-00436	
8	1	016-89-00079	21578	BRKT,ASSY,CONN MTG	EMR	016-89-00079	
9	1	016-89-00080	21578-1	BRKT,ASSY,CONN MTG	EMR	016-89-00080	
10	5	063-98-00049		CONN,RECP,22PIN@.156,PWB	CINCH	251-22-30-161 OR -160	
11	1	401-98-00009		GUIDE,CARD,LOCK TAB TYPE	STANFORD APP	1450F	
12	1	250-98-00081		SW,TOGGLE,DPDT, 3A@115V	HHSMITH/AH&H	522/81024-GB	* Q
13	1	134-98-00006		HLDR,FUSE,3AG,RTANG TERM	MML71	342004-L	
14	1	120-98-00024		FUSE,SLO-BLO,5AMP,125V	LITTELFUSE	313005	
15	AR	229-02-00077		SCREW,4-40X1/2 PAN HD	PRCMT OPTION	MS51957-17	* P
16	AR	273-02-00004		WASHER,#4, FLT ST STL	PRCMT OPTION	MS15795-803	
17	AR	273-02-00019		WASHER,#4,EXT TOOTH	PRCMT OPTION	MS35335-57	
18	AR	229-02-00272		SCREW,6-32X3/16,FLT HD	PRCMT OPTION	MS51959-25	* P
19	AR	229-02-00083		SCREW,6-32X1/4 PAN HD	PRCMT OPTION	MS51957-26	* P
20	AR	273-02-00020		WASHER,#6,EXT TOOTH	PRCMT OPTION	MS35335-58	
21	AR	229-02-00087		SCREW,6-32X1/2 PAN HD	PRCMT OPTION	MS51957-30	* P
23	AR	287-02-00019		NUT,HEX,4-40,SELF-LOCKING	PRCMT OPTION	MS21044C04	
24	2	111-98-00020		FSTNR,LCH,MAG,W/STRIKER	STANLEY	42	
26	1	140-99-00210	21968-66	INSUL,.37X4.00X.125THK	EMR	140-99-00210	
27	AR	060-11-00005		CMPD,ADHESIVE,RUBBER BASE	ARMSTRONG	520	
28	1	196-99-00156	10663	PLATE,NAME EQUIP IDENT	EMR	196-99-00156	
29	1	999-01-00001	28458	PANEL,REAR *POA VAR*			
34	AR	202-98-00010		PS,DC/DC 12V INP, 30V OUT	ARNOLD MAG	SHX-419	
36	1	196-98-00018		PLATE,IND ON/OFF	MML 43	30-5632-4	
38	1	412-99-00019	30492	IDENT,CARD LOCATION	EMR	412-99-00019	
39	1	412-99-00020	30492-1	IDENT,CARD LOCATION	EMR	412-99-00020	
40	1	205-89-01131	1956	PWA,EXTENDER	EMR	205-89-01131	
41	1	280-99-00003	28417	EXTR,CARD	EMR	280-99-00003	
42	4	178-98-00003		MOUNT,RUBBER BUMPER	ATLANT INDIA	68	
43	AR	229-02-00089		SCREW,6-32X3/4 PAN HD	PRCMT OPTION	MS51957-32	* P
REF 1	1	905-05-00384	28458	VAR CHART,MODEL 601	EMR	905-05-00384	

FIRST USAGE MODEL VTS

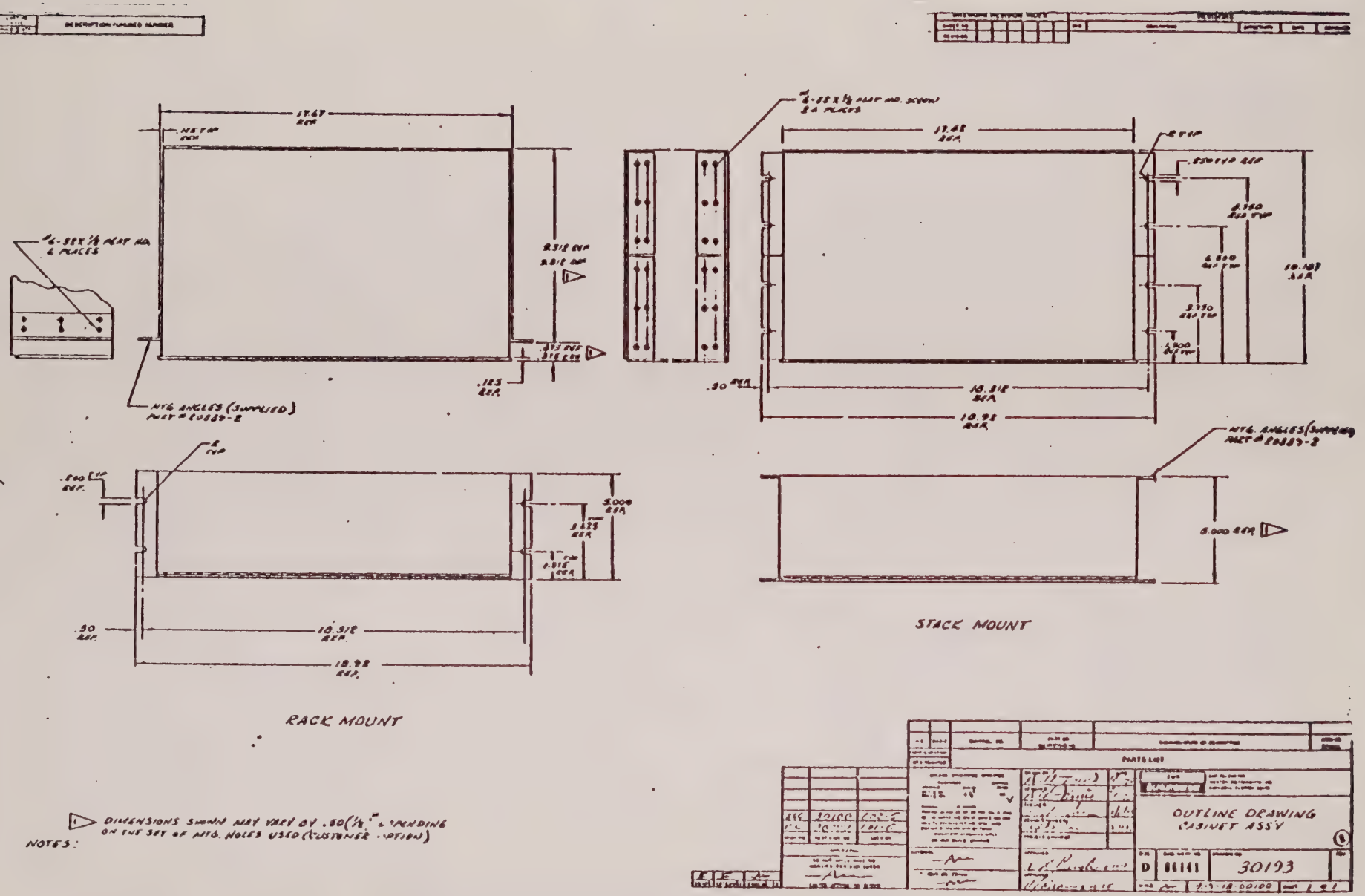

RACK MOUNT
STACK MOUNT
NOTES:
DIMENSIONS SHOWN MAY VARY BY .50(1/2") DEPENDING ON THE SET OF MTG. HOLES USED (CUSTOMER OPTION)
OUTLINE DRAWING CABINET ASSY
30193

Figure 2. Model 601-5 Dimension Drawing.

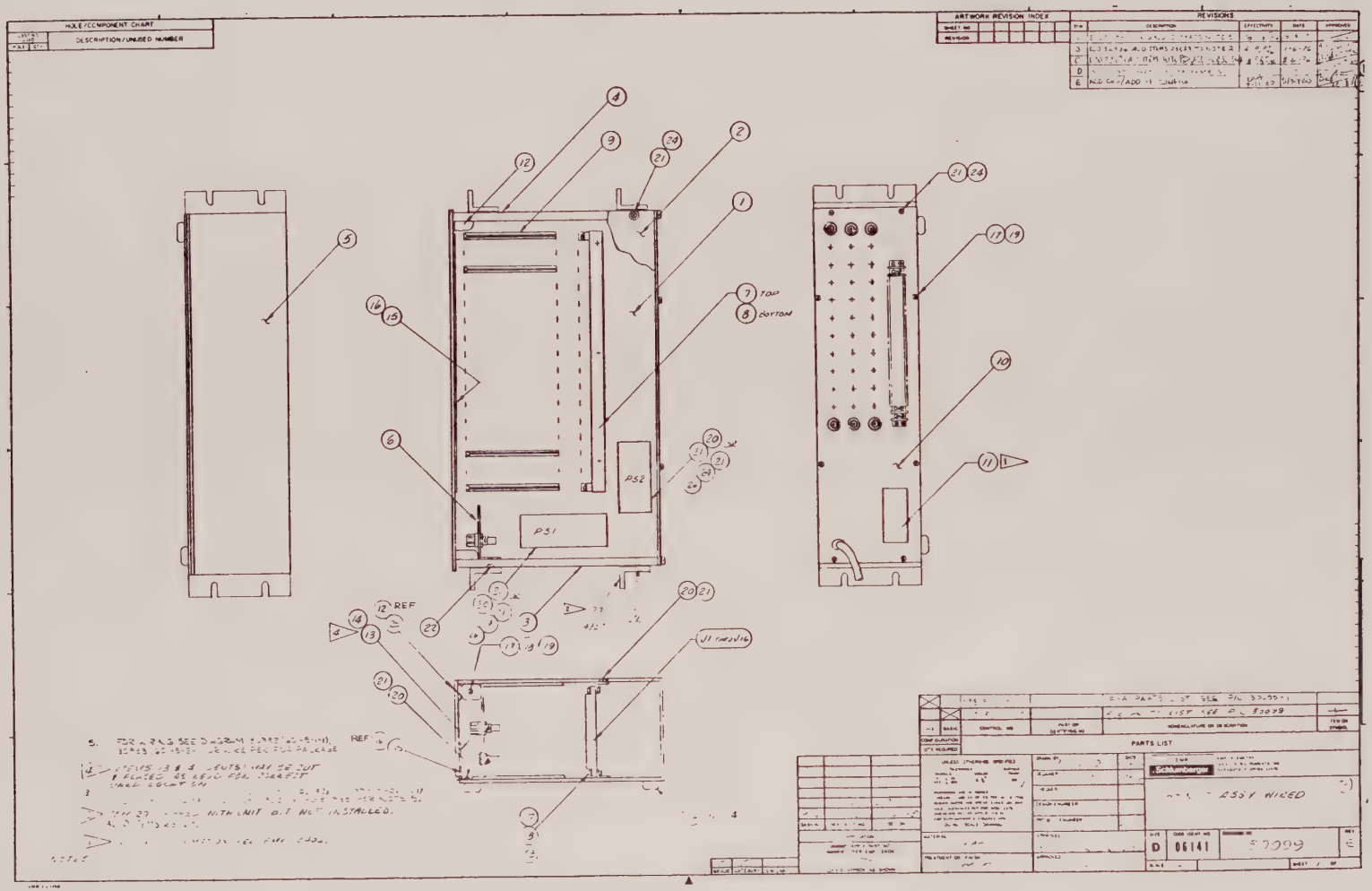


Figure 3. Model 601-5 Assembly Diagram

Table 2. Model 601-5 Assembly, Parts List

11/20/80 MG013 SANGAMO-WESTON INC. PAGE 1

ENGINEERING PARTS LIST CODE IDENT 06141

PARENT ITEM NUMBER	ITEM DESCRIPTION	I T	I C	I S	ENG REV	ECO NUMBER	S OS	Z	MFG NAME	MFG PART
023-89-00081	CAB ASSY WIRED POA E8739	1	W	2	EA	E"	RC00002		EMR	30099-1

FIND NO	COMPONENT ITEM NUMBER	ITEM DESCRIPTION	Q T	QUANTITY	UM	C T	MFG NAME	MFG PART
001	196-99-00278	PLATE,BASE	1	1	EA	1	EMR	30092
002	196-99-00196	PLATE,TOP	1	1	EA	1	EMR	20886
003	196-99-00279	PLATE,SIDE,RH	1	1	EA	1	EMR	30093
004	196-99-00280	PLATE,SIDE,LH	1	1	EA	1	EMR	30093-1
005	191-89-01178	PANEL,ASSY,FRONT	1	1	EA	1	EMR	21594-5
006	191-89-00661	PANEL,ASSY,PWR CONTROL	1	1	EA	1	EMR	23164-1
007	016-89-00113	BRKT,ASSY,CONN,MTG,TOP	1	1	EA	1	EMR	23106
008	016-89-00112	BRKT,ASSY,CONN MTG,BOTTOM	1	1	EA	1	EMR	23097
009	401-98-00009	GUIDE,CARD,LOCK TAB TYPE	1	8	EA	1	STANFORD APP	1450F
010	191-89-01241	PANEL,ASSY REAR	1	1	EA	1	EMR	24601-2
011	196-99-00156	PLATE,NAME EQUIP IDENT	1	1	EA	1	EMR	10663
012	111-98-00020	FSTNR,LCH,MAG,W/STRIKER	1	2	EA	1	STANLEY	42
013	412-99-00019	IDENT,CARD LOCATION	1	1	EA	1	EMR	30492
014	412-99-00020	IDENT,CARD LOCATION	1	1	EA	1	EMR	30492-1
015	140-99-00209	INSUL,.37X12.37X.12THK	1	1	EA	1	EMR	21966-65
016	060-11-00005	CMPD,ADHESIVE,RUBBER BASE	3	0	EA	1	ARMSTRONG	520
017	229-02-00077	SCREW,4-40X1/2 PAN HD	3	0	EA	1	PRCMT OPTION	MS51957-17
018	273-02-00004	WASHER,#4, FLT ST STL	3	0	EA	1	PRCMT OPTION	MS15795-803
019	273-02-00025	WASHER,#4,INT TOOTH	3	0	EA	1	PRCMT OPTION	MS35333-70
020	229-02-00083	SCREW,6-32X1/4 PAN HD	3	0	EA	1	PRCMT OPTION	MS51957-26
021	273-02-00026	WASHER,#6,INT TOOTH	3	0	EA	1	PRCMT OPTION	MS35333-71
022	229-02-00197	SCREW,6-32X1/2,FLT HD	3	0	EA	1	PRCMT OPTION	MS51959-30
023	287-02-00019	NUT,HEX,4-40,SELF-LOCKING	3	0	EA	1	PRCMT OPTION	MS21044C04
024	229-02-00087	SCREW,6-32X1/2 PAN HD	3	0	EA	1	PRCMT OPTION	MS51957-30
025	229-02-00272	SCREW,6-32X3/16,FLT HD	3	0	EA	1	PRCMT OPTION	MS51959-25
026	287-02-00003	NUT,HEX, 6-32	3	0	EA	1	PRCMT OPTION	MS35649-264
027	016-99-00200	BRACKET,MTG.	1	4	EA	1	EMR	20889
028	205-89-01131	PWA,EXTENDER	1	1	EA	1	EMR	1956
029	280-99-00003	EXTR,CARD	1	1	EA	1	EMR	28417
031	273-02-00020	WASHER,#6,EXT TOOTH	3	0	EA	1	PRCMT OPTION	MS35335-58

Table 2

11/20/80 AMG013 SANGAMO-WESTON INC. PAGE 2

ENGINEERING PARTS LIST CODE IDENT 06141

PARENT ITEM NUMBER	ITEM DESCRIPTION	I T	I C	I S	UM	ENG REV	ECO NUMBER	OS	S Z	MFG NAME	MFG PART
023-89-00081	CAB ASSY WIRED POA E8739	1	W	2	EA	E"	RC00002		D	EMR	30099-1

FIND NO	COMPONENT ITEM NUMBER	ITEM DESCRIPTION	Q T	QUANTITY	UM	C T	MFG NAME	MFG PART
032	178-98-00003	MOUNT,RUBBER BUMPER	1	4	EA	1	ATLANT INDIA 68	
J 001	063-98-00049	CONN,RECP,22PIN@.156,PWB	1	1	EA	1	CINCH	251-22-30-161 OR -160
J 003	063-98-00049	CONN,RECP,22PIN@.156,PWB	1	1	EA	1	CINCH	251-22-30-161 OR -160
J 014	063-98-00049	CONN,RECP,22PIN@.156,PWB	1	1	EA	1	CINCH	251-22-30-161 OR -160
J 016	063-98-00049	CONN,RECP,22PIN@.156,PWB	1	1	EA	1	CINCH	251-22-30-161 OR -160
REF001	905-18-00100	OUTLINE DWG	2	0	EA	4	EMR	30193

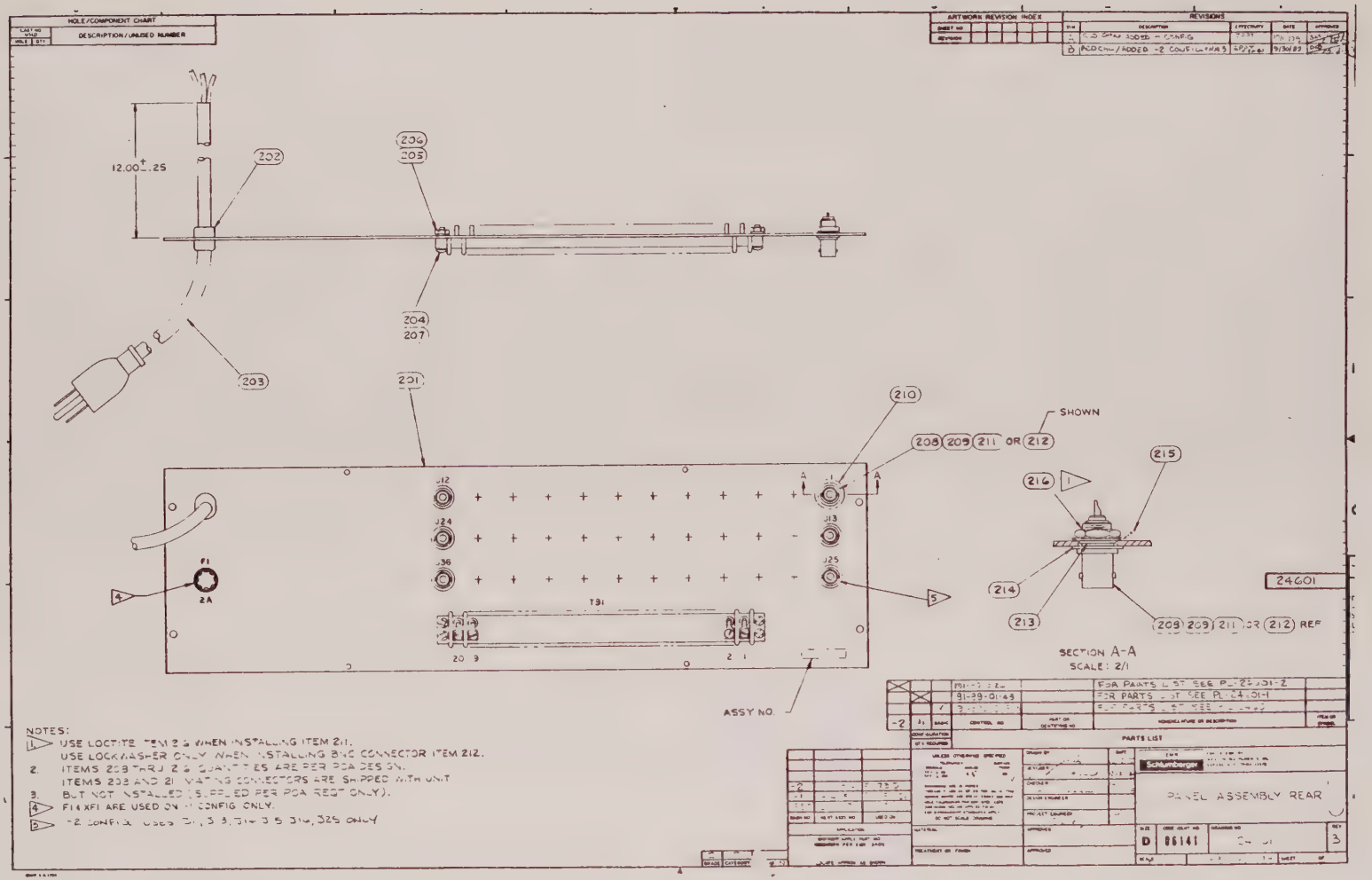


Figure 4. Rear Panel Assembly Diagram

Table 3. Rear Panel Assembly, Parts List

11/20/80 AMG013 SANGAMO-WESTON INC. PAGE 1

ENGINEERING PARTS LIST CODE IDENT 06141

PARENT ITEM NUMBER	ITEM DESCRIPTION	I T	I C	I S	UM	ENG REV	ECO NUMBER	DS	S Z	MFG NAME	MFG PART
191-89-01241	PANEL,ASSY REAR POA E8739	1	P	2	EA	B#	RC00001		D	EMR	24601-2

FIND NO	COMPONENT ITEM NUMBER	ITEM DESCRIPTION	Q T	QUANTITY	UM	C T	MFG NAME	MFG PART
201	191-99-00457	PANEL,REAR	1	1	EA	1	EMR	24602
202	022-98-00008	BUSH.,STRAIN RELIEF	1	1	EA	1	HEYMAN MFG	SR-6P3-4
203	070-98-00020	CORD,3-WIRE,SVT VINYL,3FT	1	1	EA	1	BELDEN	17280*GRAY*
204	229-02-00088	SCREW,6-32X5/8 PAN HD	1	3	EA	1	PRCMT OPTION	MS51957-31
205	287-02-00021	NUT,HEX,6-32, ST STL,.066	3	0	EA	1	QVL	NAS671-C6
206	273-02-00026	WASHER,#6,INT TOOTH	3	0	EA	1	PRCMT OPTION	MS35333-71
207	273-98-00041	WASHER,#6,FIBRE .141 ID X	1	4	EA	1	H.H. SMITH	2160
208	063-98-00151	CONN,PLUG,TWINAX	1	6	EA	1	AMPHENCL	31-224
209	063-98-00150	CONN,RECP,TWINAX	1	6	EA	1	AMPHENOL	31-223
210	290-99-00002	BUTTON,PLUG MODIFIED	1	30	EA	1	EMR	16667
211	063-02-00015	CONN,PLUG,BNC	1	6	EA	1	QVL	UG-88E/U
212	063-02-00014	CONN,RCPT,BHD,BNC COAX	1	6	EA	1	QVL	UG-1094A/U
213	273-98-00045	WASHER,PHENOLIC .385 ID	1	6	EA	1	SEASTRCM	5620-89-62
214	022-98-00002	BSHG,NYLON,BNC CONNECTOR	1	6	EA	1	MILTON RUSS	10221-N
215	255-98-00012	TERM,SLDR LUG,3/8 STUD	1	6	EA	1	H.H.SMITH	1497
216	060-11-00001	CMPD,LOCKING,FINE THREAD	1	6	EA	1	LOCTITE CORP	GRADE A /#277 RED
TP001	246-98-00012	STRIP,TERMINAL,20 TERM.	1	1	EA	1	KULKA	600-Y-20

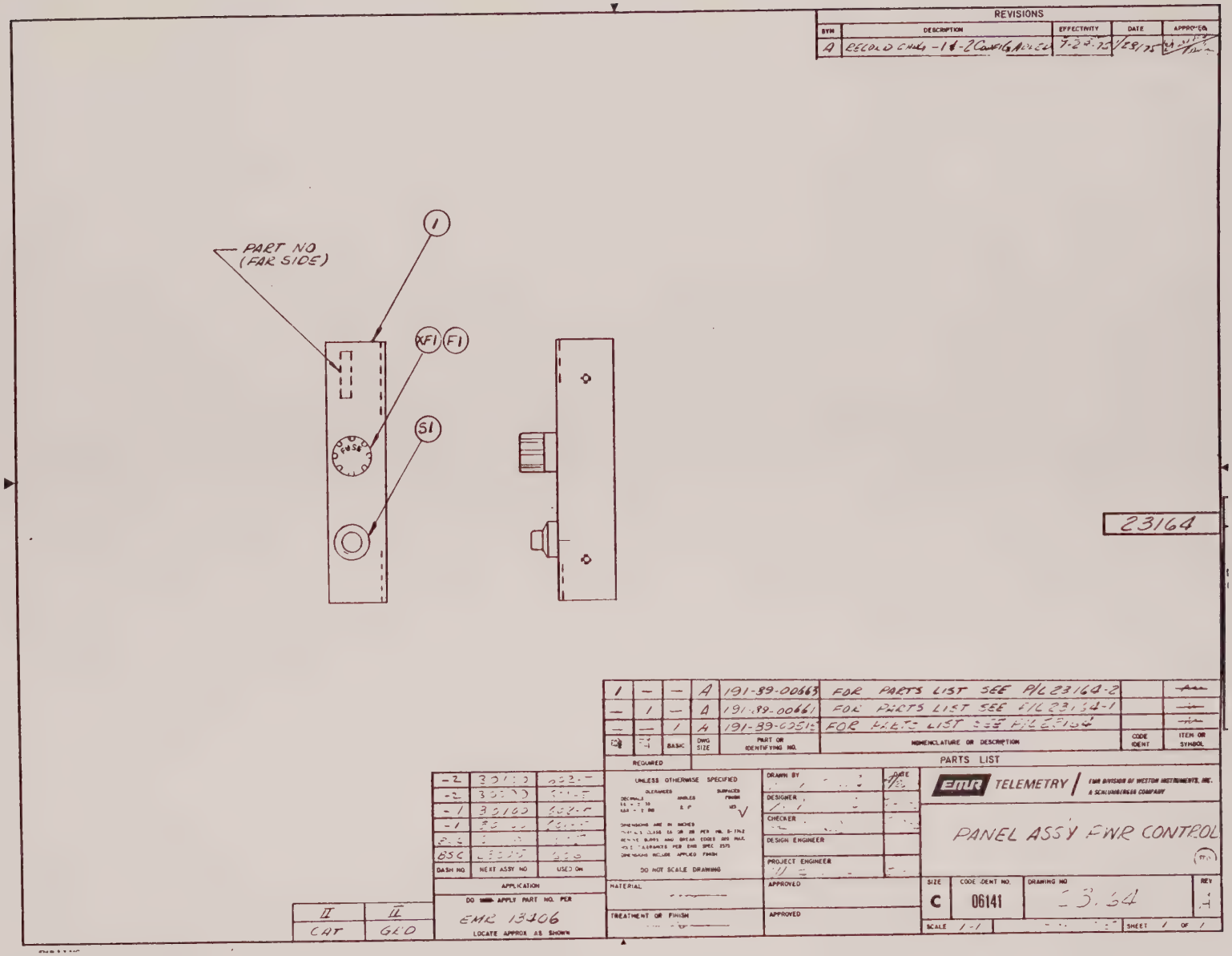


Figure 5. Power Control Panel Assembly Diagram

Table 4. Power Control Panel Assembly, Parts List

11/12/80 AMG013 SANGAMO-WESTON INC. PAGE 1

ENGINEERING PARTS LIST CODE IDENT 06141

PARENT ITEM NUMBER	ITEM DESCRIPTION	I T	I C	I S	UM	ENG REV	ECO NUMBER	DS	S Z	MFG NAME	MFG PART
191-89-00661	PANEL,ASSY,PWR CONTROL 601-5-2-1	1	P	2	EA	**	000000			EMR	23164-1

FIND NO	COMPONENT ITEM NUMBER	ITEM DESCRIPTION	Q T	QUANTITY	UM	C T	MFG NAME	MFG PART
001	191-89-00660	PANEL,SUBASSY,PWR CONTROL	1	1	EA	1	EMR	30095
F 001	120-98-00020	FUSE,SLO-BLO,1AMP,125V	1	1	EA	1	LITTELFUSE	313001
S 001	250-98-00245	SW,PUSH BUTTON LIGHTED	1	1	EA	1	MARCO CAK	416-6-1-A1H
XF001	134-98-00006	HLDR,FUSE,3AG,RTANG TERM	1	1	EA	1	MML71	342004-L

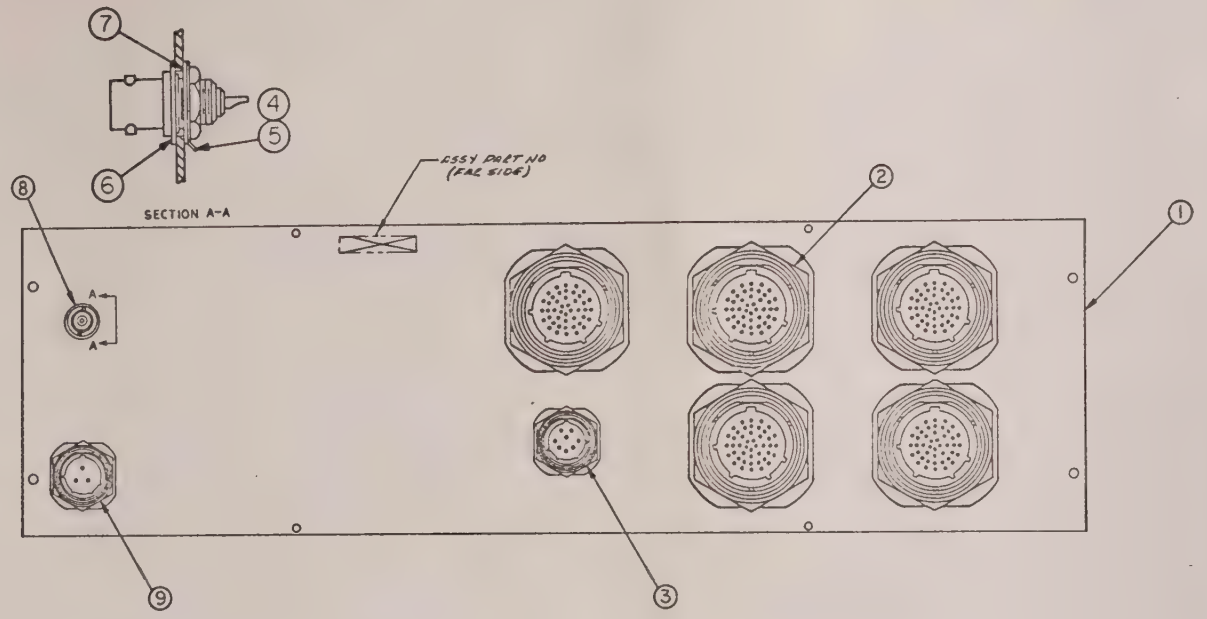


Figure 4 Rear Panel Assembly, Drawing 43785

HOLE/COMPONENT CHART	
LAST NO USED HOLE	DESCRIPTION/UNUSED NUMBER

ARTWORK REVISION INDEX						
SHEET NO						
REVISION						

REVISIONS				
SYM	DESCRIPTION	EFFECTIVITY	DATE	APPROVED

		191-89-01258	FOR PARTS LIST SEE PL-43785	
-1 BASIC	CONTROL NO.	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	ITEM OR SYMBOL
CONFIGURATION			PARTS LIST	
QTY REQUIRED				

ESC	2-4501	6J1
DASH #	NEXT ASSY NO	USED ON

UNLESS OTHERWISE SPECIFIED
TOLERANCE
DECIMALS ANGLES SURFACE FINISH
DIMENSIONS ARE IN INCHES
REMOVE BURRS AND SHARP EDGES
DO NOT SCALE DRAWING

APPLICATION
NEXT ASSY PART NO.
PER ENR 13408
LOCATE ARROW AS SHOWN

DRAWN F R HARRERT 1/26/89
ENGINEER 1/26/89
CHECKED 1/26/89
QA ENGINEER
PROJECT ENGINEER
MATERIAL
APPROVED
TREATMENT OR FINISH
APPROVED

SARASOTA FLORIDA

REAR PANEL ASSEMBLY

SIZE	CODE IDENT NO	DRAWING NO	REV
D	06141	43785	
SCALE 1/1	191-89-01258	SHEET 1 OF 1	

PROTOTYPE CONTROL | LIMITED CONTROL | STANDARD CONTROL

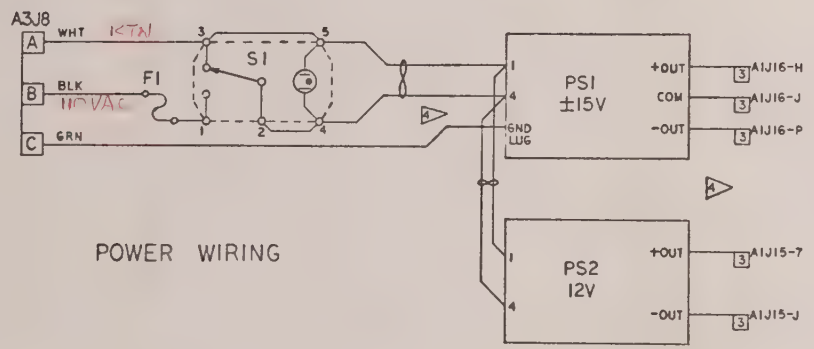
Table 3 Rear Panel Assembly, Parts List PL-43785

04/24/81 AMG013 SANGAMO-WESTON INC. PAGE 1

REQUESTED BY: ENGINEERING PARTS LIST CODE IDENT 06141

PARENT ITEM NUMBER	ITEM DESCRIPTION	I T	I C	I S	ENG UM	ECO REV	ECO NUMBER	S DS	Z	MFG NAME	MFG PART
191-89-01258	ASSY,REAR PANEL MOD 601-19	!	P	2	EA	*#	RC00001		D	EMR	43785

FIND NO	COMPONENT ITEM NUMBER	ITEM DESCRIPTION	QT	QUANTITY	UM	CT	MFG NAME	MFG PART
001	191-99-01819	PANEL,REAR	1	1	EA	1	EMR	43784
002	063-98-00588	CONN,CIRC,55CONT,RCPT	1	5	EA	1	CANNON/MML81	MS3124E22-55P
003	063-98-00606	CONN,CIRC,8CONT RCPT JAM	1	1	EA	1	BENDIX/QPL	MS3124E12-8S
004	060-11-00002	CMPD,LOCKING,FINE THREAD	3	0	EA	1	LOCTITE CORP	TYPE 222
005	255-98-00012	TERM,SLDR LUG,3/8 STUD	1	1	EA	1	H.H.SMITH	1497
006	022-98-00002	BSHG,NYLON,BNC CONNECTOR	1	1	EA	1	MILTON ROSS	10221-N
007	273-98-00045	WASHER,PHENOLIC .385 ID	1	1	EA	1	SEASTROM	5620-89-62
008	063-02-00014	CONN,RCPT,BHD,BNC COAX	1	1	EA	1	QVL	UG-1094A/U
009	063-98-00587	CONN,CIRC, 3CONT,RCPT	1	1	EA	1	CANNON/MML81	MS3124E12-3P



POWER WIRING

Figure 6 Wiring Diagram, Drawing 43787
(Sheet 1 of 3)

5 USE RG 316/U COAX (624-98-00061)

4 USE #20 STRD FOR ALL POWER WIRING

3 USE #24 STRD, 2 COND, SHLD, WHT JKT (276-02-00020)

2 USE .125 FLAT BRAID (232-98-00004)

NOTES: 1. ALL WIRE TO BE #24 STRD WHT (276-98-00102) UNLESS OTHERWISE SPECIFIED.

PARTS LIST

WIRING DIAGRAM
MODEL 601-19-0-F1338

SIZE D | CODE IDENT NO 06141 | DRAWING NO 43787

SCALE NONE | 905-19-00330 | SHEET 1 OF 3

LIMITED CHANGE

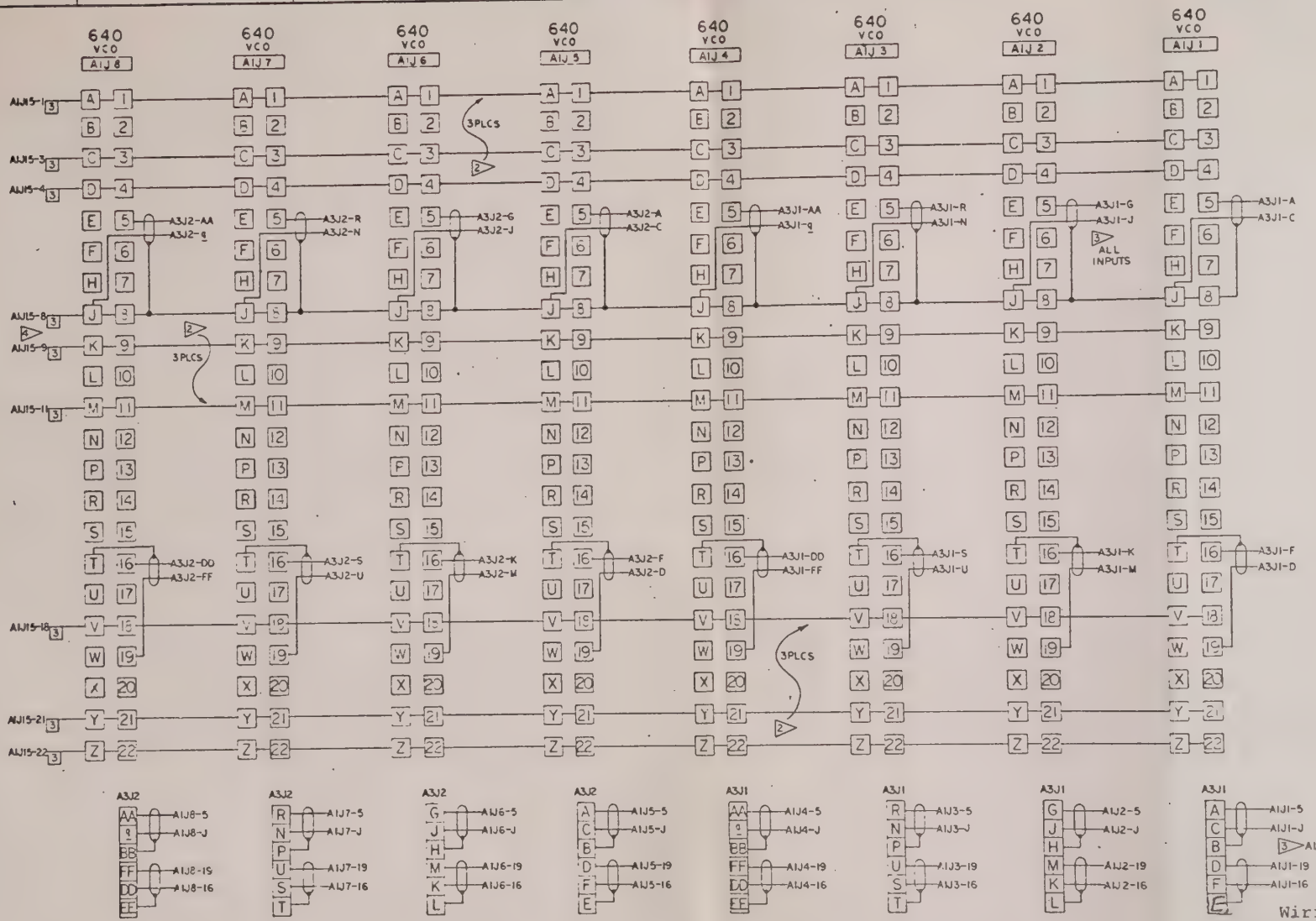


Figure 6
Wiring Diagram, Drawing 43787
(Sheet 2 of 3)

WIRING DIAGRAM
MODEL 601-19-0-F1338

SIZE	CAGE IDENT NO	DRAWING NO
D	06141	43787

SCALE — | 305-13-00630 | SHEET 2

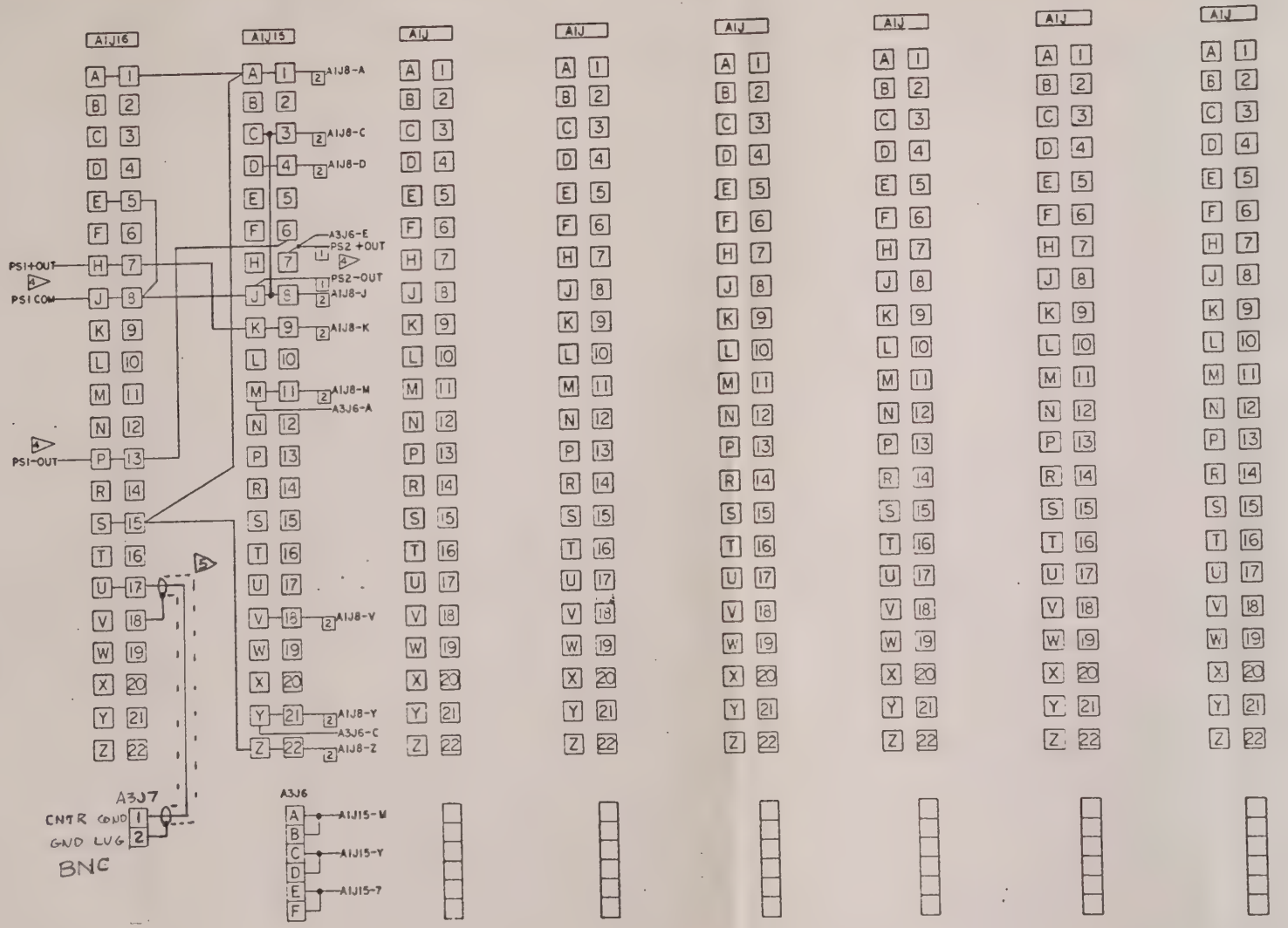


Figure 6
Wiring Diagram, Drawing 43787
(Sheet 3 of 3)

WIRING DIAGRAM
MODEL 601-19-0-F1338

SIZE	CODE IDENT NO	DRAWING NO
D	06141	43787

SECTION 3

600 SERIES PRINTED WIRING ASSEMBLIES

Model 640 Dual Channel Voltage Controlled Oscillator PWA

Model 645-02, -03, -04 Reference Oscillator/VCO/Dual Mixer Amplifier PWA

MODEL 640

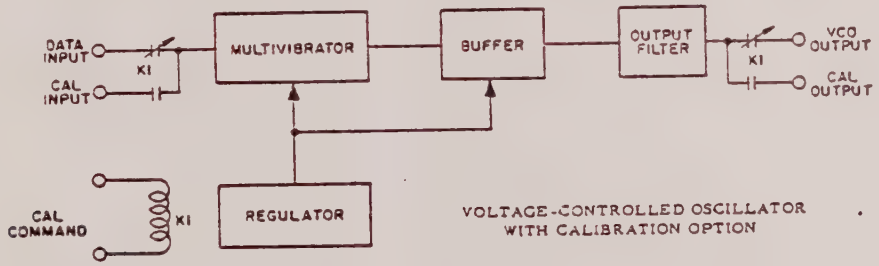
DUAL CHANNEL VOLTAGE-CONTROLLED OSCILLATOR

EMR 640 DUAL-CHANNEL VOLTAGE-CONTROLLED OSCILLATOR
(REVISION C)

1. GENERAL

The EMR 640 Dual-Channel Voltage-Controlled Oscillator is part of EMR 600-Series telemetry products designed for use in FM data acquisition applications. Included in the EMR 640 are two identical and independent voltage-controlled oscillators (VCOs) which accept high-level data input signals and provide FM subcarrier outputs. Center frequencies of 1 kHz through 200 kHz and deviations of ±2% through ±15% can be supplied. Built-in data/calibrate relays may be included for calibration of the VCO's. The calibration commands and calibration voltages are supplied by an external source such as the EMR 643 Voltage Calibrator.

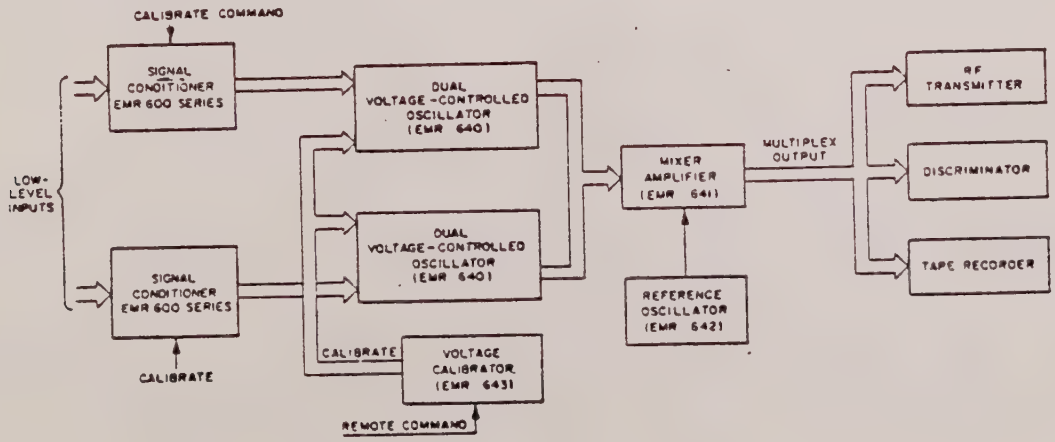
When the calibration option is included in a 640, both VCO's are equipped with the calibration relays. Separate calibration command input lines and calibration voltage input lines are provided for the two VCO's on a card. A simplified block diagram of the VCO configuration including the calibration option follows.



VOLTAGE-CONTROLLED OSCILLATOR WITH CALIBRATION OPTION

2. APPLICATION

A typical application of the EMR 640 is shown in the following diagram. This diagram illustrates the 640 and other EMR 600-Series equipment interconnected to form a typical data acquisition system.



3. TYPICAL CHARACTERISTICS

3.1 Electrical

Typical electrical characteristics for each of the two VCOs on the EMR 640 are listed as follows.

a. Subcarrier Frequencies: 1 kHz through 200 kHz.

b. Deviations: ±2% through ±15%.

c. Input Level: 5 V through 20 V peak-to-peak for full bandwidth deviation, continuously adjustable.

d. Input Impedence: Not less than 100 k Ω.

e. Deviation Polarity: Positive, output frequency increases with an input voltage increase.

f. DC Offset: Output frequency is continously adjustable from high-to-low bandedge with offset potentiometer. This enables operation from unipolar or bipolar data source devices.

g. Accuracy: Within 1% of full bandwidth.

h. Output Voltage: Sine-wave output continuously adjustable up to 4 V rms, open-circuit. A short-circuit at the output will not damage the circuit.

i. Output Impedance: Standard output impedance is 47 k ±10% for direct resistive mixing.

j. Power Requirement: +10.5 V to +14 V or +24 V to +32 V. Nominal current required is 15 milliamperes per VCO.

3.2 Mechanical and Environmental

a. Card Size: 4-½ inches high by 6-½ inches long.

b. Connectors: Cards contain a printed connector which plugs into a mating recep tacle in the mounting equipment.

c. Mounting: Intended for mounting in EMR 600-Series System Equipment Cases. Several equipment cases are available for use with various system configurations.

d. Operating Temperature Range: 32°F to 158°F.

3.3 Model Number Identification

The complete model number and digit description is as follows.

```
                    a    b   c        d   e
MODEL 640 - xx-xxxx±xxxx() -xxxx±xxxx()
```

a = Design Sequence:

01 - No Calibration Relays
02 - With Calibration Relays

b = Center Frequency in four-digit kHz
c = Peak Deviation. Four digits plus % for PBW channels, or four digits plus kHz for CBW channels.

} Channel 1

d = Center Frequency in four-digit kHz
e = Peak Deviation. Four digits plus % for PBW channels, or four digits plus kHz for CBW channels.

} Channel 2

Examples: 640-01-1.500 ±.0626 kHz - 1.750 ±.0625 kHz.

640-01-16.00 ±2.000 kHz - 24.00 ±2.00 kHz.

4. INSTALLATION

The EMR 640 is designed for installation in an EMR 600-Series system Equipment Case. A printed connector on the card mates with a 22-pin double-sided receptacle located in the equipment case. Electrical connections to the card are terminated at the mating receptacle. The electrical connections to be terminated are listed as follows.

PIN	SIGNAL	PIN	SIGNAL
1	VCO 1 OUTPUT	A	VCO 1 OUTPUT
2	- - -	B	VCO 1 SWITCHES OUTPUT
3	VCO'S 1 & 2 CAL COM RTN	C	- - -
4	VCO 1 CAP INPUT	D	- - -
5	VCO 1 DATA INPUT	E	- - -
6	- - -	F	VCO 1 28 V CAL COM*
7	- - -	H	- - -
8	GRD (VCO 1 OUTPUT RTN)	J	VCO 1 INPUT RTN
9	VCO 2 +12 V SUPPLY*	K	VCO 1 +12 V SUPPLY*
10	VCO 1 +28 V SUPPLY*	L	VCO 2 +28 V SUPPLY*
11	VCO 1 12 V CAL COM*	M	- - -
12	VCO 2 SWITCHED OUTPUT	N	- - -
13	- - -	P	- - -
14	VCO 2 28 V CAL COM*	R	- - -
15	- - -	S	- - -
16	VCO 2 INPUT RTN	T	VCO 2 OUTPUT RTN
17	- - -	U	- - -
18	VCO 2 CAL INPUT	V	- - -
19	VCO 2 DATA INPUT	W	- - -
20	- - -	X	- - -
21	VCO 2 12V CAL COM*	Y	- - -
22	VCO 2 OUTPUT	Z	VCO 2 OUTPUT

* Either a +12 V supply or a +28 V supply may be used to power the card. Connect only the desired lines for power and calibration command inputs.

5. OPERATION

5.1 Description

Operation of the EMR 640 consists of setting the quiescent parameters of the VCOs using the deviation, frequency, and output potentiometers. These potentiometers are located on the front-edge of the card for easy access. Settings at these potentiometers are located on the front-edge of the card for easy access. Settings at these potentiometers depend on the parameters of the data signals that are to drive the VCOs. A list of the potentiometers and the associated VCOs are as follows (reference Figure 1).

F.1

REF. DESIG.	NAME	VCO NO.
R15	DEV	CHANNEL 1
R4	FREQ	CHANNEL 1
R29	OUT	CHANNEL 1
R49	DEV	CHANNEL 2
R38	FREQ	CHANNEL 2
R63	OUT	CHANNEL 2

NOTE

Two other potentiometers are located in each VCO (R21/R22 and R55/R56). These controls are for temperature compensation adjustments and are set at the factory for optimum performance. No further adjustment should be required. If excessive temperature drift occurs, the card should be returned to EMR for adjustment.

The DEV potentiometers are used to set the deviation of the VCO based on the peak voltage of the data signal input. Any level between 5 V and 20 V peak-to-peak may be selected as full-bandwidth deviation. The FREQ potentiometers set the initial frequency of the VCOs. These controls vary the VCO frequencies from high-to-low bandedges of the subcarrier channels. The OUT potentiometers set the output voltage of the VCOs. Any level up to 4 V rms (open-circuit) can be selected.

5.2 Setup Procedure

The procedure supplied in this paragraph is used to set the parameters of each VCO on the card. To perform this procedure, a frequency counter, calibrator (or adjustable voltage source), and an rms voltmeter are required test equipment.

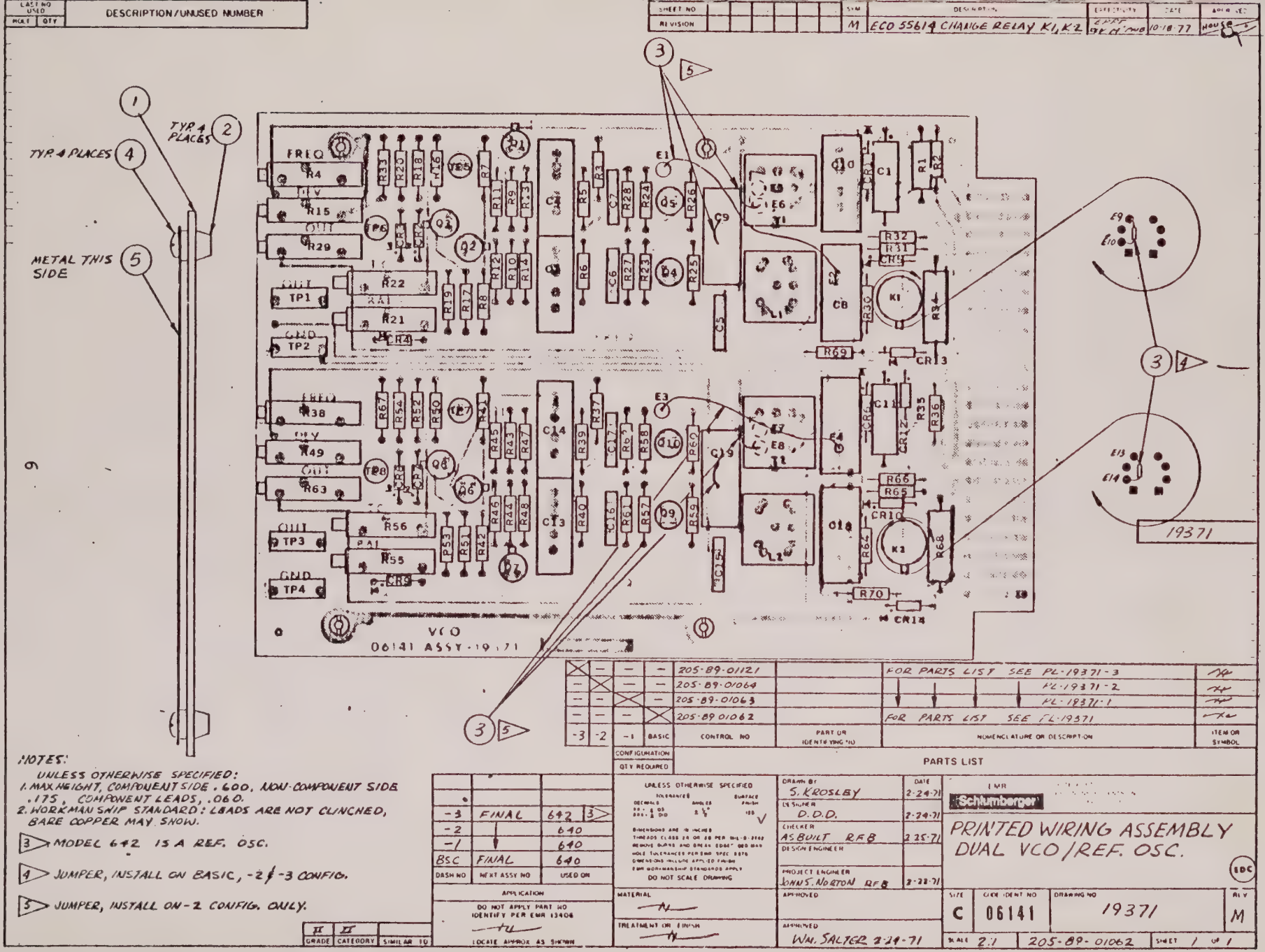


Figure 1 Printed Wiring Assembly Dual VCO/Ref. OSC.

a. Short the data inputs of the VCO to ground and connect a frequency counter to the VCO output.

b. Using the FREQ potentiometer, set the VCO frequency as follows.

   1. Positive Data Signals -- When the data sources supply voltage levels in the positive voltage region (e.g., 0 V to +5 V), the quiescent VCO frequency should be set to a frequency corresponding to low bandedge.

   2. Negative Data Signals -- When the data sources supply voltage levels in the negative voltage region (e.g., -5 V to 0 V), the quiescent VCO frequency should be set to a frequency corresponding to high bandedge.

   3. Bipolar Data Signals -- When the data sources supply voltage levels both positive and negative varying around a ground reference, the quiescent VCO frequency should be set at the center frequency.

c. Remove the ground connection at the VCO input.

d. Using a voltage calibrator or DC voltage source, supply a peak voltage level to the input and adjust the DEV potentiometer as follows.

   1. When the quiescent VCO frequency is set to low bandedge, supply the peak positive voltage at the input and adjust the DEV control to obtain a high-bandedge frequency.

   2. When the quiescent VCO frequency is set to high bandedge, supply the peak negative voltage at the input and adjust the DEV control to obtain a low-bandedge frequency.

   3. When the quiescent VCO frequency is set to center frequency, supply the peak positive (or negative) voltage at the input and adjust the DEV control to obtain a high-bandedge (or low-bandedge) frequency.

e. With the VCO output load connected, monitor the VCO output with an rms meter. Adjust the OUT potentiometer to obtain the desired output level, typically 1 V to 2 V rms.

6. THEORY OF OPERATION

The EMR 640 contains two identical and independent VCOs; each having a data input, subcarrier output, and power inputs. A high-level analog data signal input modulates the VCO frequency an amount determined by the amplitude of the input signal and by the built-in bandwidth characteristics of the VCO. The VCOs are set at the factory for operation at a specific center frequency and with a specific bandwidth (deviation) defined as a percentage of the center frequency. Any signal input bewtween 5 volts and 20 volts peak-to-peak can be used to deviate the VCO frequency from bandedge-to-bandedge. An input control is provided in each VCO to establish the voltage required to deviate the VCO from bandedge-to-bandedge. Each VCO also contains a frequency control which sets the initial frequency to center frequency or to a bandedge frequency, depending on the parameters of the data input signal. An output control in each VCO is provided to set the amplitude of the modulated subcarrier output signal. The output is continuously adjustable up to 4 volts rms into an open-circuit.

An optional calibration feature may be included in each VCO which permits calibration of the VCO's. Independent calibration voltage inputs and calibration command inputs are provided for each VCO.

The VCOs are shown schematically in Figure 2. Since the two VCOs are identical, only VCO 1 (CHANNEL A) will be discussed in this paragraph.

The data signal input is routed from card pin 5 through resistor R32 and is applied across input controls R15. The level selected at this control is applied directly to a two transistor oscillator Q1/Q2. This oscillator is a cross-coupled, free-running circuit which supplies the subcarrier frequency. Frequency control R4 sets the quiescent frequency of the oscillator, while the deviation of the VCO is determined by the amplitude of the input signal as selected at R15.

A temperature compensation circuit supplies a reference voltage to the oscillator which changes as the environmental conditions change. However, the reference voltage change is inversely proportional to the temperature change effect on the oscillator. A diode bridge network in conjunction with transistor Q3 supplies the reference voltage to the oscillator. As temperature changes occur, the bridge is offset which changes the biasing of Q3. The reference voltage at the Q3 collector changes correspondingly.

The oscillator outputs, collectors of Q1 and Q2, are routed to a cross-coupled buffer stage consisting of Q4 and Q5. This buffer serves as a squaring circuit and a driver for the output filter (T1, C9, L1, and C10). The buffer isolates the oscillator from the unit output, thereby eliminating any change of the oscillator frequency because of output loading.

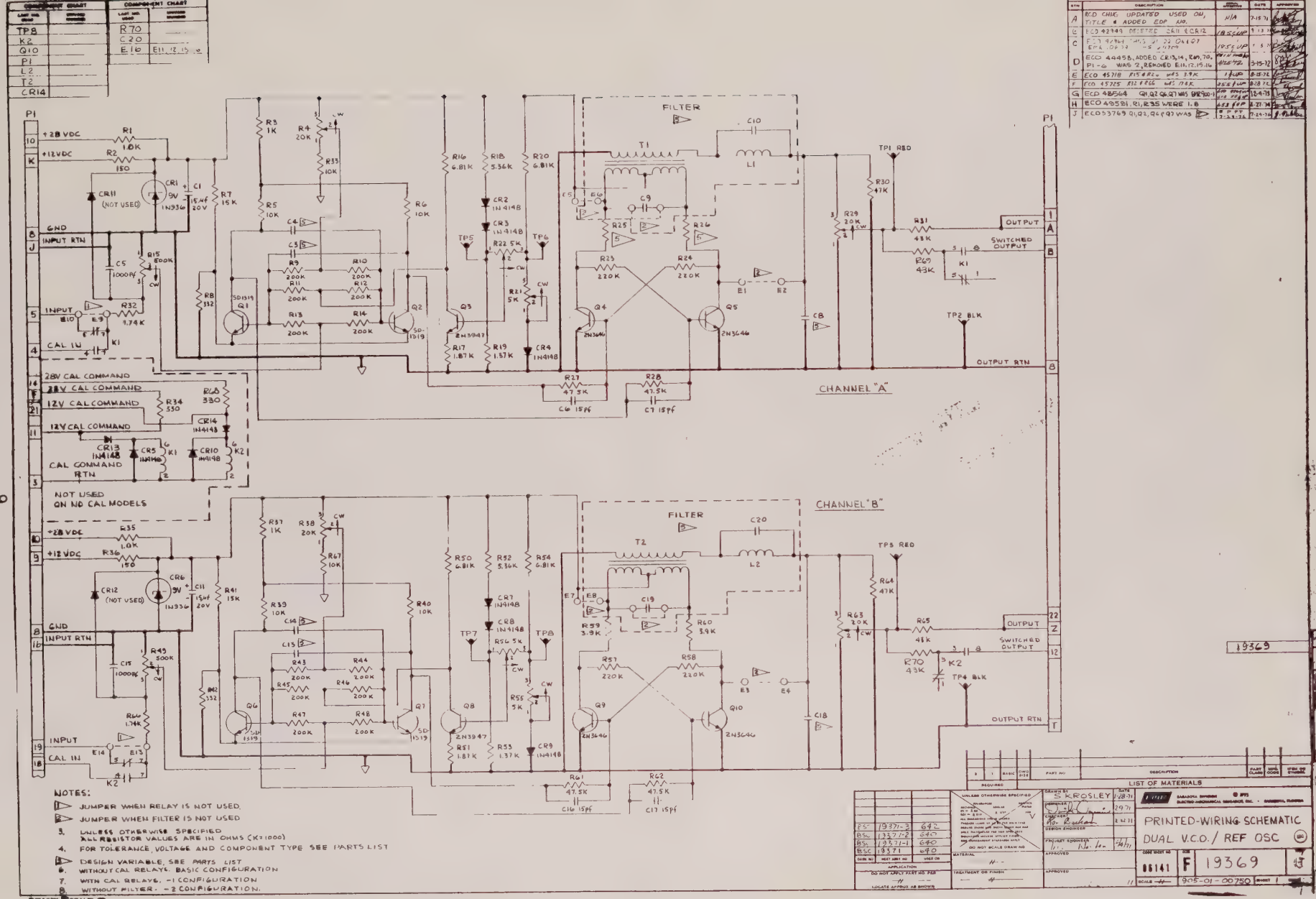


Figure 2 EMR 640 Dual-Channel Voltage Controlled Oscillator Schematic Diagram

Driver transistors Q4 and Q5 supply the square-sided subcarrier to a bandpass output filter which filters the square-wave signal and provides a sine-wave subcarrier signal across output control R29. This control is used to set the amplitude of the VCO output signal routed to card pins 1 and A.

Two power connections are supplied to each VCO, a +12 Vdc terminal and a +28 Vdc terminal. Either of the two connections can be used as the power input depending on the power source used for the system. Both inputs are routed to a regulator stage (CR1) which regulates the power level input at +9 volts as required by the VCO circuits.

When the calibration feature is included, relays K1 and K2 are provided to switch the VCO's input from the normal data source to a calibration voltage input. The output of the VCO is automatically switched, as well as the data input, when a calibration mode is selected. Jumpers are installed across the relay locations when the relays are not included. Two separate calibration command lines are provided to each relay, a +12 V command and a +28 V command. Either of the two lines can be used depending on the power source used for the system.

7. MAINTENANCE

Maintenance to the card consists of replacing a defective component should a malfunction occur. To assist in localizing a malfunction, certain key waveforms in the VCO circuit are provided (Figure 3) and voltage levels at the transistor terminals are provided (Table 1).

There are no maintenance adjustments to be made in the unit. Three operating adjustments [frequency, input level (deviation), and output level] are described in Paragraph 5. Two other controls in each VCO are for temperature compensation adjustments which are made at the factory. No further adjustments should be necessary. If excessive temperature drift occurs, the card should be returned to EMR for readjustment.

8. PARTS LIST

A complete list of all components on the EMR 640 is contained in Tables 2 and 3. These lists include parts for both versions (with calibration and without calibration) of the card. The assembly number for the cards without calibration is EMR assembly 19371; cards with calibration are EMR Assembly 19371-1. Figure 2 identifies the components associated with the calibration option.

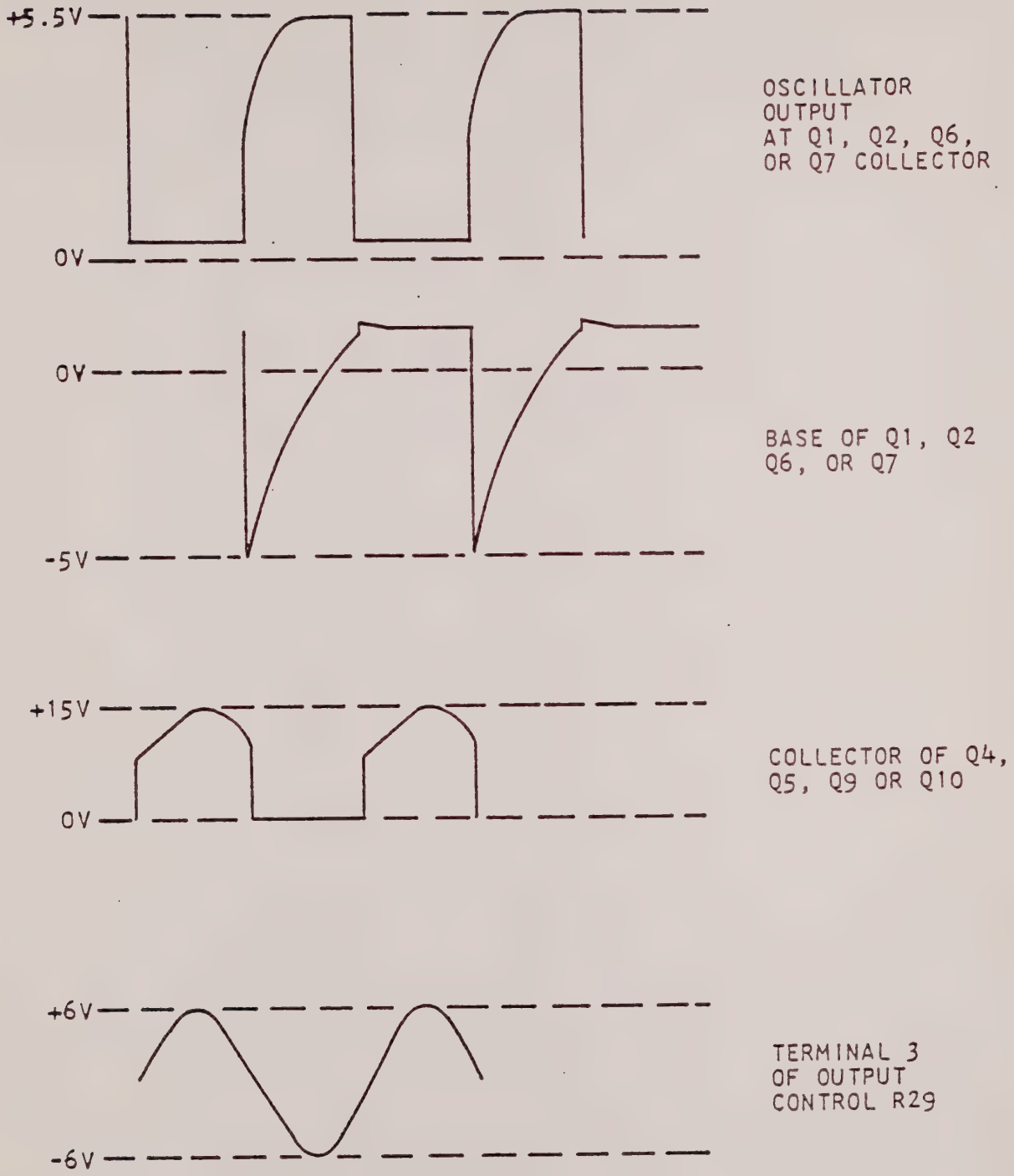


Figure 3 VCO Circuit Typical Waveforms

Table 1 VCO Transistor Voltage Measurements

TRANSISTOR	EMITTER	BASE	COLLECTOR
Q1	+0.5V	---	+3.5V
Q2	+0.5V	---	+3.5V
Q3	+1.0V	+1.6V	+5.4V
Q4	0.0V	+0.5V	+7.0V
Q5	0.0V	+0.5V	+7.0V
Q6	+0.5V	---	+3.5V
Q7	+0.5V	---	+3.5V
Q8	+1.0V	+1.6V	+5.4V
Q9	0.0V	+0.5V	+7.0V
Q10	0.0V	+0.5V	+7.0V

NOTES:

1. Use oscilloscope for voltage measurements.

2. Values listed are average DC voltages of the observed waveforms.

PARTS LIST 19371 REV DATE 09/02/76 REV LTR K
LIST TITLE PWA,DUAL VCO W/O CAL RLY CHGE CONT NO. CODE IDENT SHT 1 OF 3
PART NO. 205-89-01062 ECO 53770 06141 CKD BY D. Landers

ITEM NO.	QTY REQD	E M R NUMBER	DRAWING OR SPEC NO.	DESCRIPTION
1	1	204-99-00697	19370	PWB,DUAL VCO
2	4	421-98-00001		INSERT,THREADED,4-40NC-2
3	AR	276-02-00004		WIRE,#28,SOL, WHT, 600V
4	4	229-02-00074		SCREW,4-40X5/16 PAN HD
5	1	232-99-00071	23026	SHIELD,PWB,GROUND
C 1	1	337-13-15004	601	CAP., 15MF 10% 20V
C 3	1	999-01-00006	19372	CAP,*POA VAR*
C 4	1	999-01-00007	19372	CAP,*POA VAR*
C 5	1	304-62-10000	600	CAP. 1000PF 1% 100V
C 6	1	304-01-01509	600	CAP. 15PF .5PF 500V
C 7	1	304-01-01509	600	CAP. 15PF .5PF 500V
C 8	1	999-01-00003	19372	CAP,*POA VAR*
C 9	1	999-01-00001	19372	CAP,*POA VAR*
C 10	1	999-01-00002	19372	CAP,*POA VAR*
C 11	1	337-13-15004	601	CAP., 15MF 10% 20V
C 13	1	999-01-00013	19372	CAP,*POA VAR*
C 14	1	999-01-00014	19372	CAP,*POA VAR*
C 15	1	304-62-10000	600	CAP. 1000PF 1% 100V
C 16	1	304-01-01509	600	CAP. 15PF .5PF 500V
C 17	1	304-01-01509	600	CAP. 15PF .5PF 500V
C 18	1	999-01-00010	19372	CAP,*POA VAR*
C 19	1	999-01-00008	19372	CAP,*POA VAR*
C 20	1	999-01-00009	19372	CAP,*POA VAR*
CR 1	1	088-10-09360		DIODE,REF,9V/7.5MA,.005 %
CR 2 THRU CR 4	3	088-10-41480		DIODE,SW,75V/5UA,4NS/10MA
CR 6	1	088-10-09360		DIODE,REF,9V/7.5MA,.005 %
CR 7 THRU CR 9	3	088-10-41480		DIODE,SW,75V/5UA,4NS/10MA
L 1	1	999-01-00004	19372	IDCTR,*POA VAR*
L 2	1	999-01-00011	19372	IDCTR,*POA VAR*
Q 1	1	263-47-00049		XSTR,NPN SW,HS, 60NA IBL
Q 2	1	263-47-00049		XSTR,NPN SW,HS, 60NA IBL
Q 3	1	263-10-39470		XSTR,NPN 40V SW-AMPL,HFE
Q 4	1	263-10-36460		XSTR,NPN 40V,300MA SW,ON
Q 5	1	263-10-36460		XSTR,NPN 40V,300MA SW,ON
Q 6	1	263-47-00049		XSTR,NPN SW,HS, 60NA IBL
Q 7	1	263-47-00049		XSTR,NPN SW,HS, 60NA IBL

Table 2 PWA, DUAL VCO W/O CAL RLY (Sheet 2 of 3)

ITEM NO.	QTY REQD	E M R NUMBER	DRAWING OR SPEC NO.	DESCRIPTION
Q 8	1	263-10-39470		XSTR,NPN 40V SW-AMPL,HFE
Q 9	1	263-10-36460		XSTR,NPN 40V,300MA SW,ON
Q 10	1	263-10-36460		XSTR,NPN 40V,300MA SW,ON
R 1	1	622-02-10000		RES. 1K 5% 1/2W
R 2	1	616-02-15009		RES,150 OHM 5% 1/4W
R 3	1	608-09-10000	624	RES. 1K 1% 1/10W
R 4	1	201-98-00105		POT,TRMR, 20 K 10%.75W
R 5	1	608-09-10001	624	RES. 10K 1% 1/10W
R 6	1	608-09-10001	624	RES. 10K 1% 1/10W
R 7	1	608-09-15001	624	RES, 15.0K 1% 1/10W
R 8	1	608-09-33209	624	RES, 332.0 OHM 1% 1/10W
R 9	6	608-09-20002	624	RES, 200.0K 1% 1/10W
THRU				
R 14				
R 15	1	201-98-00109		POT,TRMR,500 K 10%.75W
R 16	1	608-09-68100	624	RES. 6.81K 1% 1/10W
R 17	1	608-09-18700	624	RES, 1.87K 1% 1/10W
R 18	1	608-09-53600	624	RES, 5.36K 1% 1/10W
R 19	1	608-09-13700	624	RES. 1.37K OHM 1% 1/10W
R 20	1	608-09-68100	624	RES. 6.81K 1% 1/10W
R 21	1	201-98-00033		POT,TRMR,5.0 K 10% 1W
R 22	1	201-98-00033		POT,TRMR,5.0 K 10% 1W
R 23	1	616-02-22002		RES,220K 5% 1/4W
R 24	1	616-02-22002		RES,220K 5% 1/4W
R 25	1	616-02-39000		RES,3.9K 5% 1/4W
R 26	1	616-02-39000		RES,3.9K 5% 1/4W
R 27	1	608-09-47501	624	RES, 47.5K 1% 1/10W
R 28	1	608-09-47501	624	RES, 47.5K 1% 1/10W
R 29	1	201-98-00105		POT,TRMR, 20 K 10%.75W
R 30	1	616-02-47001		RES,47K 5% 1/4W
R 31	1	616-02-43001		RES,43K 5% 1/4W
R 32	1	608-09-17400	624	RES, 1.74K 1% 1/10W
R 33	1	608-09-10001	624	RES. 10K 1% 1/10W
R 35	1	622-02-10000		RES. 1K 5% 1/2W
R 36	1	616-02-15009		RES,150 OHM 5% 1/4W
R 37	1	608-09-10000	624	RES. 1K 1% 1/10W
R 38	1	201-98-00105		POT,TRMR, 20 K 10%.75W
R 39	1	608-09-10001	624	RES. 10K 1% 1/10W
R 40	1	608-09-10001	624	RES. 10K 1% 1/10W
R 41	1	608-09-15001	624	RES, 15.0K 1% 1/10W
R 42	1	608-09-33209	624	RES, 332.0 OHM 1% 1/10W
R 43	6	608-09-20002	624	RES, 200.0K 1% 1/10W
THRU				
R 48				

EDC

ITEM NO.	QTY REQD	E M R NUMBER	DRAWING OR SPEC NO.	DESCRIPTION Table 2 PWA, DUAL VCO W/O CAL RLY (Sheet 3 of 3)
R 49	1	201-98-00109		POT,TRMR,500 K 10%.75W
R 50	1	608-09-68100	624	RES. 6.81K 1% 1/10W
R 51	1	608-09-18700	624	RES, 1.87K 1% 1/10W
R 52	1	608-09-53600	624	RES, 5.36K 1% 1/10W
R 53	1	608-09-13700	624	RES. 1.37K OHM 1% 1/10W
R 54	1	608-09-68100	624	RES. 6.81K 1% 1/10W
R 55	1	201-98-00033		POT,TRMR,5.0 K 10% 1W
R 56	1	201-98-00033		POT,TRMR,5.0 K 10% 1W
R 57	1	616-02-22002		RES,220K 5% 1/4W
R 58	1	616-02-22002		RES,220K 5% 1/4W
R 59	1	616-02-39000		RES,3.9K 5% 1/4W
R 60	1	616-02-39000		RES,3.9K 5% 1/4W
R 61	1	608-09-47501	624	RES, 47.5K 1% 1/10W
R 62	1	608-09-47501	624	RES, 47.5K 1% 1/10W
R 63	1	201-98-00105		POT,TRMR, 20 K 10%.75W
R 64	1	616-02-47001		RES,47K 5% 1/4W
R 65	1	616-02-43001		RES,43K 5% 1/4W
R 66	1	608-09-17400	624	RES, 1.74K 1% 1/10W
R 67	1	608-09-10001	624	RES. 10K 1% 1/10W
T 1	1	999-01-00005	19372	XFMR,*POA VAR*
T 2	1	999-01-00012	19372	XFMR,*POA VAR*
TP 1	1	143-98-00051		JACK,TEST PT,PW TYPE,RED
TP 2	1	143-98-00005		JACK,TEST,BLACK
TP 3	1	143-98-00051		JACK,TEST PT,PW TYPE,RED
TP 4	1	143-98-00005		JACK,TEST,BLACK
TP 5 THRU TP 8	4	143-98-00023		JACK,TEST PT,PW TYPE,WHT
REF 1	1	905-01-00750	19369	SCHEMATIC,DUAL VCO
REF 2	1	905-05-00294	19372	VARIABLE CHART,DUAL VCO
REF 3	1	905-04-00001	9500	SPEC,COMPONENT SPACING

Table 3 PWA, DUAL VCO WITH CAL RLY (Sheet 2 of 3)

ITEM NO.	QTY REQD	E M R NUMBER	DRAWING OR SPEC NO.	DESCRIPTION
Q 4	1	263-10-36460		XSTR,NPN 40V,300MA SW,ON
Q 5	1	263-10-36460		XSTR,NPN 40V,300MA SW,ON
Q 6	1	263-47-00049		XSTR,NPN SW,HS, 60NA IBL
Q 7	1	263-47-00049		XSTR,NPN SW,HS, 60NA IBL
Q 8	1	263-10-39470		XSTR,NPN 40V SW-AMPL,HFE
Q 9	1	263-10-36460		XSTR,NPN 40V,300MA SW,ON
Q 10	1	263-10-36460		XSTR,NPN 40V,300MA SW,ON
R 1	1	622-02-10000		RES. 1K 5% 1/2W
R 2	1	616-02-15009		RES,150 OHM 5% 1/4W
R 3	1	608-09-10000	624	RES. 1K 1% 1/10W
R 4	1	201-98-00105		POT,TRMR, 20 K 10%.75W
R 5	1	608-09-10001	624	RES. 10K 1% 1/10W
R 6	1	608-09-10001	624	RES. 10K 1% 1/10W
R 7	1	608-09-15001	624	RES, 15.0K 1% 1/10W
R 8	1	608-09-33209	624	RES, 332.0 OHM 1% 1/10W
R 9	6	608-09-20002	624	RES, 200.0K 1% 1/10W
THRU				
R 14				
R 15	1	201-98-00109		POT,TRMR,500 K 10%.75W
R 16	1	608-09-68100	624	RES. 6.81K 1% 1/10W
R 17	1	608-09-18700	624	RES, 1.87K 1% 1/10W
R 18	1	608-09-53600	624	RES, 5.36K 1% 1/10W
R 19	1	608-09-13700	624	RES. 1.37K OHM 1% 1/10W
R 20	1	608-09-68100	624	RES. 6.81K 1% 1/10W
R 21	1	201-98-00033		POT,TRMR 5 K 10% 1W
R 22	1	201-98-00033		POT,TRMR 5 K 10% 1W
R 23	1	616-02-22002		RES,220K 5% 1/4W
R 24	1	616-02-22002		RES,220K 5% 1/4W
R 25	1	616-02-39000		RES,3.9K 5% 1/4W
R 26	1	616-02-39000		RES,3.9K 5% 1/4W
R 27	1	608-09-47501	624	RES, 47.5K 1% 1/10W
R 28	1	608-09-47501	624	RES, 47.5K 1% 1/10W
R 29	1	201-98-00105		POT,TRMR, 20 K 10%.75W
R 30	1	616-02-47001		RES,47K 5% 1/4W
R 31	1	616-02-43001		RES,43K 5% 1/4W
R 32	1	608-09-17400	624	RES, 1.74K 1% 1/10W
R 33	1	608-09-10001	624	RES. 10K 1% 1/10W
R 34	1	623-02-33009		RES. 330 OHM 5% 1W
R 35	1	622-02-10000		RES. 1K 5% 1/2W
R 36	1	616-02-15009		RES,150 OHM 5% 1/4W
R 37	1	608-09-10000	624	RES. 1K 1% 1/10W
R 38	1	201-98-00105		POT,TRMR, 20 K 10%.75W
R 39	1	608-09-10001	624	RES. 10K 1% 1/10W
R 40	1	608-09-10001	624	RES. 10K 1% 1/10W

DATA SUPPLIES, INC

Table 3 PWA, DUAL VCO WITH CAL RLY (Sheet 3 of 3)

ITEM NO.	QTY REQD	E M R NUMBER	DRAWING OR SPEC NO.	DESCRIPTION
R 41	1	608-09-15001	624	RES, 15.0K 1% 1/10W
R 42	1	608-09-33209	624	RES, 332.0 OHM 1% 1/10W
R 43 THRU R 48	6	608-09-20002	624	RES, 200.0K 1% 1/10W
R 49	1	201-98-00109		POT,TRMR,500 K 10%.75W
R 50	1	608-09-68100	624	RES. 6.81K 1% 1/10W
R 51	1	608-09-18700	624	RES, 1.87K 1% 1/10W
R 52	1	608-09-53600	624	RES, 5.36K 1% 1/10W
R 53	1	608-09-13700	624	RES. 1.37K OHM 1% 1/10W
R 54	1	608-09-68100	624	RES. 6.81K 1% 1/10W
R 55	1	201-98-00033		POT,TRMR 5 K 10% 1W
R 56	1	201-98-00033		POT,TRMR 5 K 10% 1W
R 57	1	616-02-22002		RES,220K 5% 1/4W
R 58	1	616-02-22002		RES,220K 5% 1/4W
R 59	1	616-02-39000		RES,3.9K 5% 1/4W
R 60	1	616-02-39000		RES,3.9K 5% 1/4W
R 61	1	608-09-47501	624	RES, 47.5K 1% 1/10W
R 62	1	608-09-47501	624	RES, 47.5K 1% 1/10W
R 63	1	201-98-00105		POT,TRMR, 20 K 10%.75W
R 64	1	616-02-47001		RES,47K 5% 1/4W
R 65	1	616-02-43001		RES,43K 5% 1/4W
R 66	1	608-09-17400	624	RES, 1.74K 1% 1/10W
R 67	1	608-09-10001	624	RES. 10K 1% 1/10W
R 68	1	623-02-33009		RES. 330 OHM 5% 1W
R 69	1	616-02-43001		RES,43K 5% 1/4W
R 70	1	616-02-43001		RES,43K 5% 1/4W
T 1	1	999-01-00005	19372	XFMR,*POA VAR*
T 2	1	999-01-00012	19372	XFMR,*POA VAR*
TP 1	1	143-98-00051		JACK,TEST PT,PW TYPE,RED
TP 2	1	143-98-00005		JACK,TEST,BLACK
TP 3	1	143-98-00051		JACK,TEST PT,PW TYPE,RED
TP 4	1	143-98-00005		JACK,TEST,BLACK
TP 5 THRU TP 8	4	143-98-00023		JACK,TEST PT,PW TYPE,WHT
REF 1	1	905-01-00750	19369	SCHEMATIC,DUAL VCO
REF 2	1	905-05-00294	19372	VARIABLE CHART,DUAL VCO
REF 3	1	905-04-00001	9500	SPEC,COMPONENT SPACING

DATA SUPPLIES INC

MODEL 645-02, -03, -04

REFERENCE OSCILLATOR/VCO/DUAL MIXER AMPLIFIER

EMR 645-02, -03 AND -04 REFERENCE OSCILLATOR/ VCO/DUAL MIXER AMPLIFIER

1. GENERAL

The EMR 645 Reference Oscillator/VCO/Dual Mixer Amplifier is part of EMR 600-Series telemetry products designed for use in FM data acquisition applications. Several configurations of the 645 are available as follows.

- EMR 645-02: This unit contains a reference oscillator and two independent mixing amplifiers.
- EMR 645-03: This unit contains a voltage-controlled oscillator (VCO) and two independent mixing amplifiers.
- EMR 645-04: This unit contains two independent mixing amplifiers only.

The reference oscillator (in the 645-02) provides a stable, low-distortion, reference signal for use in systems requiring tape speed compensation. Any single reference frequency from 1 kHz to 400 kHz may be supplied.

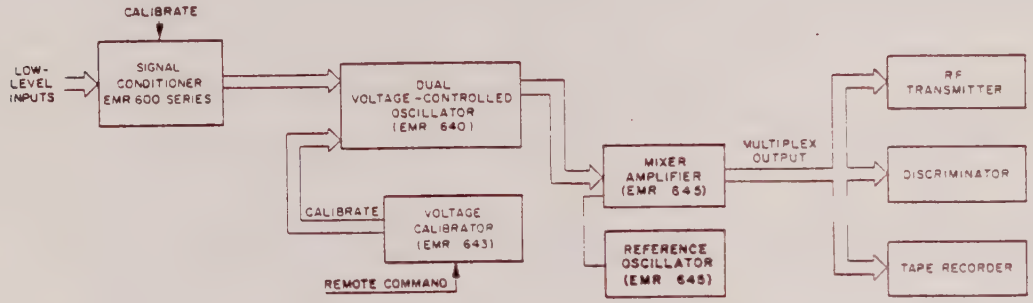
The VCO used in the 645-03 accepts high-level data input signals and provides FM subcarrier outputs. Center frequencies of 1 kHz through 200 kHz and deviations of ±2% through ±15% can be supplied. Built-in data/calibrate relays may be included for calibration of the VCOs.

The dual mixer amplifiers used in all three configurations (-02, -03 and -04) are designed for use in the summing and level control of the EMR 640 VCO outputs, but are adaptable to many different customer requirements. A level control is provided with each amplifier. In all cases, the amplifier outputs are suitable for driving low impedance lines. The available gain is 0 dB to -20 dB for the reference input, while the gain available at the mixer input depends upon source resistance.

Additional options to the basic configurations of the 645 are available upon special request. These options include transformer coupled outputs, external meter outputs, and switched VCO/reference oscillator outputs.

2. APPLICATION

A typical application of the 645 is shown in the following diagram. This diagram illustrates the 645-02 and other EMR 600-Series equipment interconnected to form typical data acquisition systems.



The reference oscillator is designed for use in systems where the FM multiplex is to be recorded and played back through demodulation equipment. Time base errors introduced into the data subcarrier frequencies as a result of tape-speed variations will cause frequency variations in the reference signal that are directly proportional to the tape-speed variations. In this application, the data subcarrier frequencies are summed with the reference frequency in a 645 mixer amplifier providing a composite FM multiplex. The multiplex output may then be recorded as required.

During playback, the reference signal is separated from the FM multiplex and demodulated by a reference discriminator in the same manner as data subcarriers are demodulated. The demodulated reference signal is then applied to the data discriminators to correct for any time base errors.

Real-time systems may be configured similarly except that the reference oscillator is not required. The 645 mixer amplifier sums the FM multiplex and supplies the multiplex to an RF amplifier for transmitting to a receiving station. The FM multiplex may also be transmitted to a receiving station via a hardwire communication line connection. A 645 mixer amplifier may be used for this application since the amplifier supplies a low-impedance, high-current output.

3. TYPICAL CHARACTERISTICS

As described in Paragraph 1, three types of independent circuits (reference oscillators, VCOs and mixing amplifiers) are used in configuring the 645-02, -03 and -04. Characteristics of the reference oscillator are listed in Paragraph 3.1. VCO characteristics are listed in Paragraph 3.2 and mixer amplifier characteristics are provided in Paragraph 3.3. Power requirement (for all configurations) is provided in Paragraph 3.4 and mechanical and environmental characteristics are described in Paragraph 3.5. Model number identification is contained in Paragraph 3.6.

3.1 Reference Oscillator (used on 645-02)

a. Output Frequencies: Any single frequency from 1 kHz through 400 kHz.

b. Reference Frequency Accuracy: Preset at EMR to ±0.15% of design frequency. Fine tuning is available at a card potentiometer.

c. Output Voltage: Sine-wave output is adjustable to 4 V rms, open-circuit. The oscillator cannot be damaged by a short-circuit at the output.

d. Output Impedance: Standard output impedance is 47k ± 10% for direct resistive mixing.

e. Card-Mounted Controls:

1. Frequency Potentiometer - Enables fine-tuning adjustment of reference frequency output.

2. Output Amplitude Potentiometer - Enables output level adjustment from 0.2 V rms to not less than 4 V rms.

3. Test Points - Output and ground.

3.2 Voltage-Controlled Oscillator (used on 645-03)

a. Subcarrier Frequencies: 1 kHz through 200 kHz.

b. Deviations: ±2% through ±15%.

c. Input Level: 5 V through 20 V peak-to-peak for full bandwidth deviation, continuously adjustable.

d. Input Impedance: Not less than 100 kΩ.

e. Deviation Polarity: Positive, output frequency increases with an input voltage increase.

f. DC Offset: Output frequency is continuously adjustable from high-to-low bandedge with offset potentiometer. This enables operation from unipolar or bipolar data source devices.

g. Accuracy: Within 1% of full bandwidth.

h. Output Voltage: Sine-wave output continuously adjustable up to 4 V rms, open-circuit. A short-circuit at the output will not damage the circuit.

i. Output Impedance: Standard output impedance is 47k Ω ± 10% for direct resistive mixing.

3.3 Mixer Amplifiers (Used on all 645 Configurations)

a. Input Impedance: Reference Input-47k Ω .
Mixer Input-100 Ω .

b. Gain Range: Reference Input - 0 dB to - 12 dB. Mixer Input Mixer Input - Depends on source resistance. (Rs in)

$$G = \frac{50 \times 10^3}{R_S + 100}$$

c. Frequency Response: Within ±1 dB, dc through 300 kHz.

d. Distortion: 1% of total harmonic distortion.

e. Output: 6 V rms open-circuit or 3V rms into a 50 Ω load.

f. Card-Mounted Controls:

1. Gain potentiometers for each amplifier.
2. Output and ground test jacks for each amplifier.

3.4 Power Requirement (All 645 Configurations)

±15 V ±5%, 30 mA nominal current.

3.5 Mechanical and Environmental

a. Card Size: 4-½ inches high by 6-½ inches long.

b. Connectors: Card contains a printed, double-sided connector which plugs into a mating receptacle in the mounting equipment.

c. Mounting: Intended for mounting in EMR 600-Series System Equipment Cases. Several equipment cases are available for use with various system configurations.

d. Operating Temperature Range: 32°F to 150°F.

3.6 Model Number Identification

a c

1. Model 645-02-xxxx-xx

a b c

2. Model 645-03-xxxx±xxxx( )-xx

3. Model 645-04

a = Center frequency in kHz.

b = Peak deviation. Four digits and percent (%) for PBW channels; four digits plus (kHz) for CBW channels.

c = 01 - No calibration relays.
02 - With calibration relays.

4. INSTALLATION

The EMR 645 is designed for installation in a 600 Series System Equipment Case. A printed connector on the card mates with a 22-pin double-sided receptacle located in the equipment case. Electrical connections to the card are terminated at the mating receptacle. The electrical connections to be terminated are listed in the following table.

PIN	SIGNAL	PIN	SIGNAL
1	Reference Osc./VCO Output	A	Reference Osc./VCO Output
2	Reference Osc./VCO Output (Switched)	B	Reference Osc./VCO Output (Switched)
3	- - -	C	- - -
4	- - -	D	- - -
5	VCO Input	E	VCO Input
6	- - -	F	- - -
7	+15 V Supply Input	H	+15 V Supply Input
8	Reference Osc./VCO Output Return	J	Reference Osc./VCO Output Return
9	+12 V Supply Input	K	+12 V Supply Input
10	+28 V Supply Input	L	+28 V Supply Input
11	- - -	M	- - -
12	- - -	N	- - -
13	-15 V Supply Input	P	-15 V Supply Input
14	Mixer #1 Input Return	R	Mixer #1 Input Return
15	Mixer #1 FM Mux Input	S	Mixer #1 FM Mux Input
16	Mixer #1 Reference Input	T	Mixer #1 Reference Input
17	Mixer #1 Output	U	Mixer #1 Output
18	DC Supply Return	V	DC Supply Return
19	Mixer #2 Output	W	Mixer #2 Output
20	Mixer #2 Reference Input	X	Mixer #2 Reference Input
21	Mixer #2 Input Return	Y	Mixer #2 Input Return
22	Mixer #2 FM Mux Input	Z	Mixer #2 FM Mux Input

Two terminals are provided for each connection to the card. Either terminal may be used. Refer to the system wiring for actual connections made to the mating receptacle.

5. OPERATION

5.1 Reference Oscillator

The reference oscillator operation consists of adjusting the oscillator to output the reference frequency and setting the rms output voltage as required. The output voltage can be set to any level up to 4 V rms, open-circuit.

NOTE

Two other potentiometers are located in the reference oscillator (R21/R22). These controls are for temperature compensation adjustments and are set at the factory for optimum performance. If excessive temperature drift occurs, the card should be returned to EMR for adjustment.

The frequency and output adjustments are performed as follows (reference card assembly diagram, Figure 1).

a. Ascertain that the deviation (DEV) potentiometer (R15) is rotated fully counterclockwise to connect the oscillator input to ground potential.

b. Using a frequency meter, monitor card test jack TP1 and rotate frequency potentiometer R4 until the reference frequency is obtained.

c. Terminate the reference oscillator output to the normal external load.

d. Connect an rms meter to card test jack TP1 and rotate output potentiometer R29 until the desired output is obtained (typically 1 V to 2 V rms).

5.2 Voltage Controlled Oscillator (VCO)

5.2.1 Description

Operation consists of setting the quiescent parameters of the VCO using the deviation, frequency, and output potentiometers. These potentiometers are located on the front-edge of the card for easy access. Settings at these potentiometers depend on the parameters of the data signals that are to drive the VCO. The potentiometers are as follows (reference Figure 1).

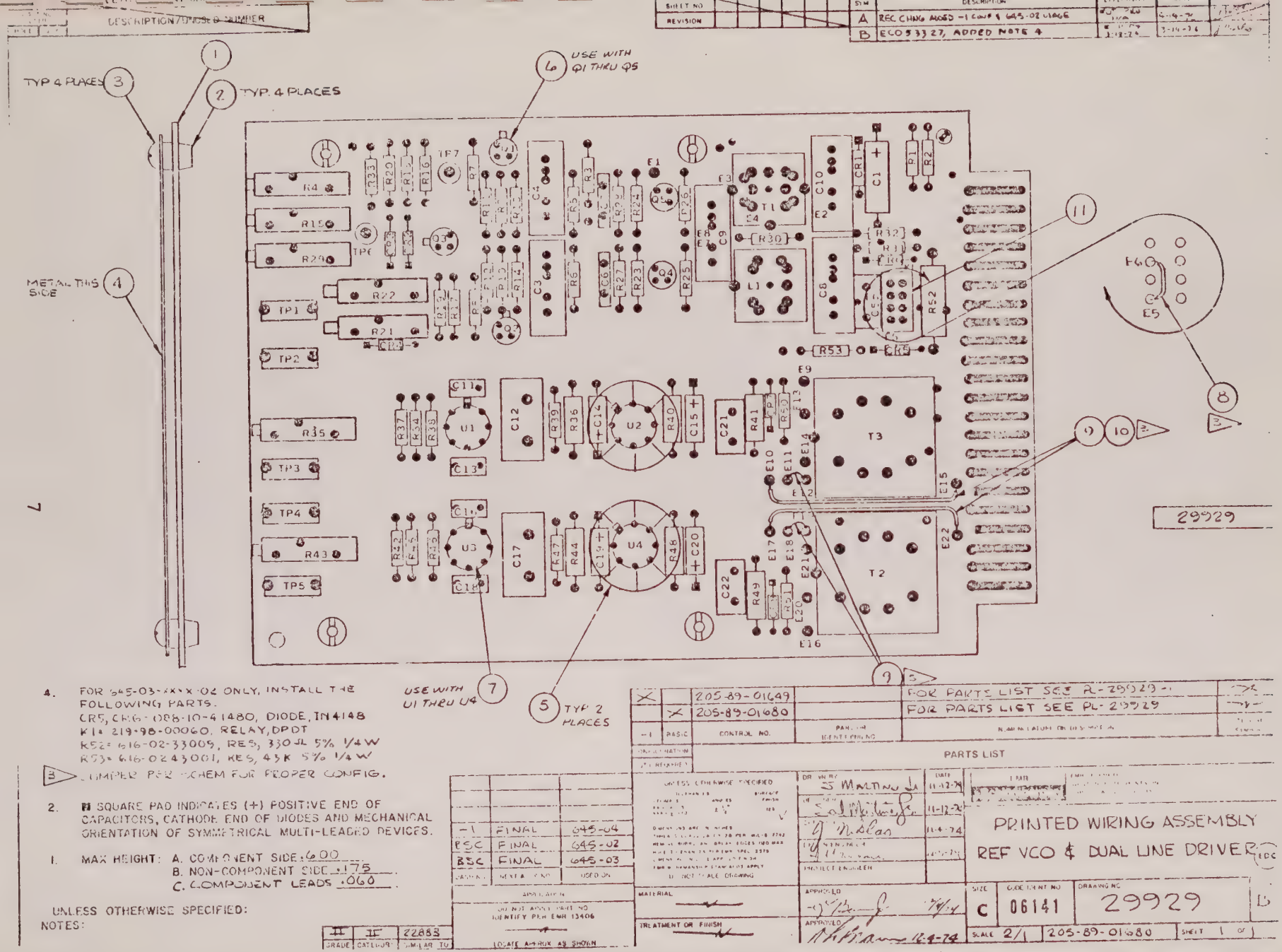

DESCRIPTION/DWG & NUMBER
REVISION
A REC CHNG ADDED -1 CONFIG 645-02 USAGE
B ECO 53327, ADDED NOTE 4
TYP 4 PLACES
TYP. 4 PLACES
METAL THIS SIDE
USE WITH Q1 THRU Q5
USE WITH U1 THRU U4
TYP 2 PLACES
29929
4. FOR 645-03-XXX-02 ONLY, INSTALL THE FOLLOWING PARTS.
CR5, CR6 - 088-10-41480, DIODE, IN4148
K1 = 219-98-00060, RELAY, DPDT
R52 = 616-02-33009, RES, 330 JL 5% 1/4W
R53 = 616-02243001, RES, 43K 5% 1/4W
3. JUMPER PER SCHEM FOR PROPER CONFIG.
2. SQUARE PAD INDICATES (+) POSITIVE END OF CAPACITORS, CATHODE END OF DIODES AND MECHANICAL ORIENTATION OF SYMMETRICAL MULTI-LEADED DEVICES.
1. MAX HEIGHT: A. COMPONENT SIDE .600
B. NON-COMPONENT SIDE .175
C. COMPONENT LEADS .060
UNLESS OTHERWISE SPECIFIED:
NOTES:
205-89-01649
205-89-01680
FOR PARTS LIST SEE PL-29929
FOR PARTS LIST SEE PL-29929
CONTROL NO.
PARTS LIST
PRINTED WIRING ASSEMBLY
REF VCO & DUAL LINE DRIVER
-1 FINAL 645-04
PSC FINAL 645-02
BSC FINAL 645-03
DRAWING NO 29929
SIZE C
CODE IDENT NO 06141
SCALE 2/1
205-89-01680
SHEET 1 OF 1
22883

Figure 1 EMR 645-02, 645-03 and 645-04 Assembly Diagram

REF. DESIG.	NAME
R15	DEV
R4	FREQ
R29	OUT

NOTE

Two other potentiometers are located on the VCO (R21/R22). These controls are for temperature compensation adjustments and are set at the factory for optimum performance. No further adjustment should be required. If excessive temperature drift occurs, the card should be returned to EMR for adjustment.

The DEV potentiometer is used to set the deviation of the VCO based on the peak voltage of the data signal input. Any level between 5 V and 20 V peak-to-peak may be selected as full-bandwidth deviation. The FREQ potentiometer sets the initial frequency of the VCO. These controls vary the VCO frequencies from high-to-low bandedges of the subcarrier channels. The OUT potentiometer sets the output voltage of the VCO. Any level up to 4 V rms (open-circuit) can be selected.

5.2.2 Setup Procedure

The procedure supplied in this paragraph is used to set the parameters of the VCO. To perform this procedure, a frequency counter, calibrator (or adjustable voltage source), and an rms voltmeter are required test equipment.

a. Short the data inputs of the VCO to ground and connect a frequency counter to the VCO output.

b. Using the FREQ potentiometer, set the VCO frequency as follows.

1. Positive Data Signals - When the data sources supply voltage levels in the positive voltage region (e.g., 0 V to +5 V), the quiescent VCO frequency should be set to a frequency corresponding to low bandedge.

2. Negative Data Signals - When the data sources supply voltage levels in the negative voltage region (e.g.,

-5 V to 0 V), the quiescent VCO frequency should be set to a frequency corresponding to high bandedge.

3. Bipolar Data Signals - When the data sources supply voltage levels both positive and negative varying around a ground reference, the quiescent VCO frequency should be set at the center frequency.

c. Remove the ground connection at the VCO input.

d. Using a voltage calibrator or DC voltage source, supply a peak voltage level to the input and adjust the DEV potentiometer as follows.

1. When the quiescent VCO frequency is set to low bandedge, supply the peak positive voltage at the input and adjust the DEV control to obtain a high-bandedge frequency.

2. When the quiescent VCO frequency is set to high bandedge, supply the peak negative voltage at the input and adjust the DEV control to obtain a low-bandedge frequency.

3. When the quiescent VCO frequency is set to center frequency, supply the peak positive (or negative) voltage at the input and adjust the DEV control to obtain a high-bandedge (or low-bandedge) frequency.

e. With the VCO output load connected, monitor the VCO output with an rms meter. Adjust the OUT potentiometer to obtain the desired output level, typicaly 1 V to 2 V rms.

5.3 Mixer Amplifiers

The operation of mixer amplifiers consists of adjusting the gain potentiometer in each of the two amplifiers. Separate potentiometers and test jacks are provided for the mixer amplifiers as follows (reference Figure 1).

MIXER AMPLIFIER	ADJUST POTENTIOMETER	TEST JACK
CIRCUIT #1 CIRCUIT #2	R35 R43	TP3 TP5

To adjust a mixer amplifier, route the FM multiplex and reference to the mixer amplifier input and monitor the circuit output with an oscilloscope. Terminate the circuit output into the normal external load and adjust the appropriate potentiometer (R35 or R43) to obtain the desired peak-to-peak output as monitored at the test jack. The output level will depend on the type of unit or transmission line that the circuit is driving and will typically be 3 volts peak-to-peak.

6. THEORY OF OPERATION

6.1 Voltage Controlled Oscillator (Used in the 645-03)

Sheet 1 of Figure 2 is the detailed schematic of the VCO and should be used with this discussion. As shown on the schematic, the VCO has a data input, a subcarrier input and power inputs. A high-level analog data signal input modulates the VCO frequency an amount determined by the amplitude of the input signal and by the built-in bandwidth characteristics of the VCO. The VCO is set at the factory for operation at a specific center frequency and with a specific bandwidth (deviation) defined as a percentage of the center frequency. Any signal input between 5 volts and 20 volts peak-to-peak can be used to deviate the VCO frequency from bandedge-to-bandedge. An input control is provided on the VCO to establish the voltage required to deviate the VCO from bandedge-to-bandedge. The VCO also contains a frequency control which sets the initial frequency to center frequency or to a bandedge frequency, depending on the parameters of the data input signal. An output control on the VCO is provided to set the amplitude of the modulated subcarrier output signal. The output is continuously adjustable up to 4 volts rms into an open-circuit. An optional calibration feature may be included on the VCO which permits VCO calibration.

The data signal input is routed from card pin 5 through resistor R32 and is applied across input control R15. The level selected at this control is applied directly to a two transistor oscillator Q1/Q2. This oscillator is a cross-coupled, free-running circuit which supplies the subcarrier frequency. Frequency control R4 sets the quiescent frequency of the oscillator, while the deviation of the VCO is determined by the amplitude of the input signal as selected at R15.

A temperature compensation circuit supplies a reference voltage to the oscillator which changes as the environmental conditions change. However, the reference voltage change is inversely proportional to the temperature change effect on the oscillator. A diode bridge network in conjunction with transistor Q3 supplies the reference voltage to the oscillator. As temperature changes occur, the bridge is offset which changes the biasing of Q3 and the reference voltage at the Q3 collector changes correspondingly.

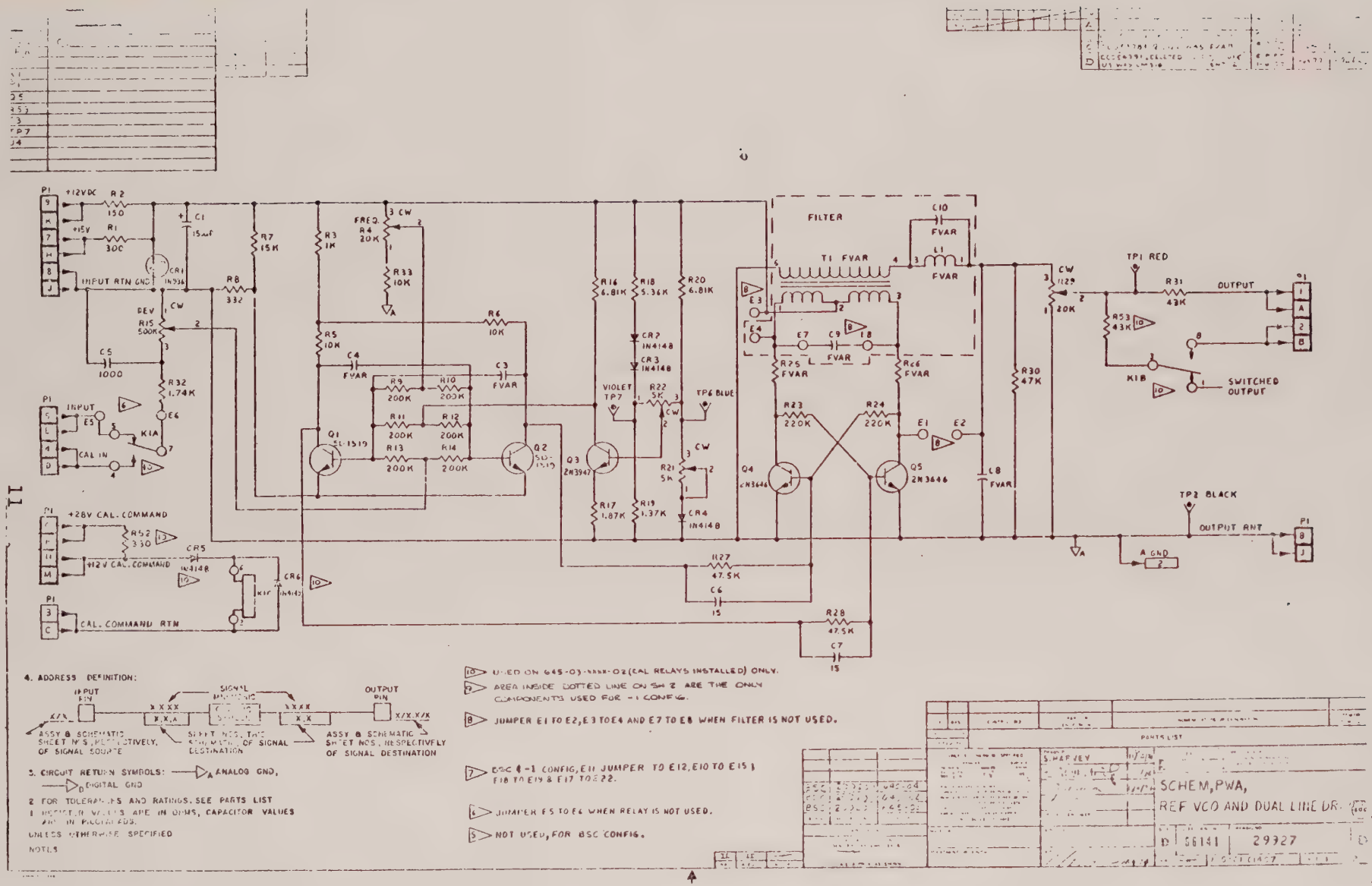

+12VDC
+15V
INPUT RTN GND
CAL IN
+28V CAL. COMMAND
+12V CAL. COMMAND
CAL. COMMAND RTN
FREQ.
FILTER
T1 FVAR
L1 FVAR
TP1 RED
OUTPUT
SWITCHED OUTPUT
TP2 BLACK
OUTPUT RNT
A GND
VIOLET TP7
TP6 BLUE
Q1 SE-1519
Q2 SE-1519
Q3 2N3947
Q4 2N3646
Q5 2N3646
4. ADDRESS DEFINITION:
INPUT PIN
SIGNAL MNEMONIC
OUTPUT PIN
ASSY & SCHEMATIC SHEET NOS. RESPECTIVELY, OF SIGNAL SOURCE
SHEET NOS. THIS SCHEMATIC OF SIGNAL DESTINATION
ASSY & SCHEMATIC SHEET NOS. RESPECTIVELY OF SIGNAL DESTINATION
5. CIRCUIT RETURN SYMBOLS: ANALOG GND, DIGITAL GND
2 FOR TOLERANCES AND RATINGS, SEE PARTS LIST
UNLESS OTHERWISE SPECIFIED
NOTES:
10 USED ON 645-03-XXXX-02 (CAL RELAYS INSTALLED) ONLY.
9 AREA INSIDE DOTTED LINE ON SH 2 ARE THE ONLY COMPONENTS USED FOR -1 CONFIG.
8 JUMPER E1 TO E2, E3 TO E4 AND E7 TO E8 WHEN FILTER IS NOT USED.
7 BSC # -1 CONFIG, E11 JUMPER TO E12, E10 TO E15, E18 TO E19 & E17 TO E22.
6 JUMPER E5 TO E6 WHEN RELAY IS NOT USED.
5 NOT USED, FOR BSC CONFIG.
PARTS LIST
SCHEM, PWA,
REF VCO AND DUAL LINE DR.
S. MARVEY
SIZE 66141
29327

Figure 2 EMR 645-02, 645-03 and 645-04 Schematic Diagram
(Sheet 1 of 2)

645-02, -03, -04

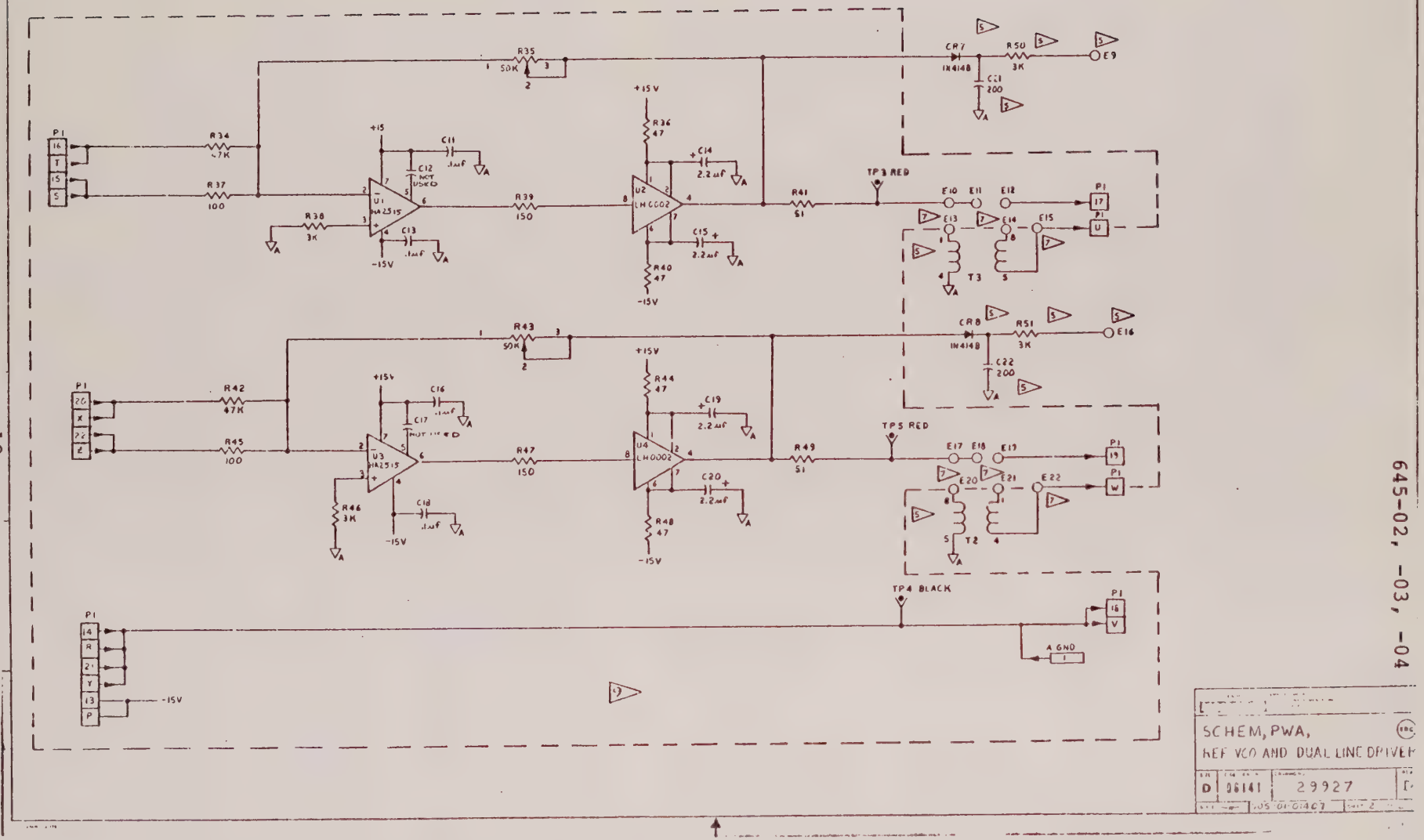


Figure 2 EMR 645-02, 645-03 and 645-04 Schematic Diagram
(Sheet 2 of 2)

The oscillator outputs, collectors of Q1 and Q2, are routed to a cross-coupled buffer stage consisting of Q4 and Q5. This buffer serves as a squaring circuit and a driver for the output filter (T1, C9, L1, and C10). The buffer isolates the oscillator from the unit output, thereby eliminating any change of the oscillator frequency because of output loading.

Driver transistors Q4 and Q5 supply the square-sided subcarrier to a bandpass output filter which filters the square-wave signal and provides a sine-wave subcarrier signal across output control R29. This control is used to set the amplitude of the VCO output signal routed to card pins 1 and A.

Two power connections are supplied to each VCO, a +12 Vdc terminal and a +15 Vdc terminal. Either of the two connections can be used as the power input depending on the power source used for the system. Both inputs are routed to a regulator stage (CR1, C1) which regulates the power level input at +9 volts as required by the VCO circuits.

When the calibration feature is included, relay K1 is provided to switch the VCO's input from the normal data source to a calibration voltage input. The output of the VCO is automatically switched, as well as the data input, when a calibration mode is selected. Jumpers are installed across the relay locations when the relays are not included. Two separate calibration command lines are provided to each relay, a +12 V command and a +28 V command. Either of the two lines can be used depending on the power source used for the system.

6.2 Reference Oscillator (Used on 645-02)

The reference oscillator is basically the same circuit as the VCO described in Paragraph 6.1 and illustrated on sheet 1 of Figure 2. When this circuit is used as a reference oscillator, DEV potentiometer R15 is set fully CW so that the oscillator input is at ground potential. In this manner, the oscillator (Q1 and Q2) is a free-running multivibrator, set to operate at the selected reference frequency. Timing components C3 and C4 are installed to set the operating frequency. Frequency control R4 is a fine tuning frequency adjustment.

Operation of the remaining reference oscillator circuits is as described in the last five paragraphs of 6.1. Power requirements and the calibration option are also as described in these paragraphs.

6.3 Mixer Amplifiers

All configurations of the 645 contain two identical and independent mixer amplifier circuits, each having two inputs; an FM

multiplex input and a reference oscillator input. The two inputs to an amplifier are resistively mixed and applied across an adjust potentiometer as shown in the block diagram on the following page. This diagram illustrates the configuration of either mixer amplifier circuit. The detailed circuit configuration is shown in sheet 2 of Figure 2.

The gain potentiometer (R35 or R43) is used to adjust the output level of the circuit. The maximum gain available at the amplifier output is a function of the input used and the source impedance. Nominal gain may be calculated by:

$$G = \frac{50 \times 10^3}{R_S + R_i + 100}$$

Where R_S is the source impedance and R_i is the input impedance of the amplifier (47k or 100 ohms).

7. MAINTENANCE

Maintenance to the 645 cards consists of replacing a defective component should a malfunction occur. To assist in localizing a malfunction in the VCO and reference oscillator, certain key waveforms are provided (Figure 3) and typical voltage levels at transistor terminals are provided (Table 1).

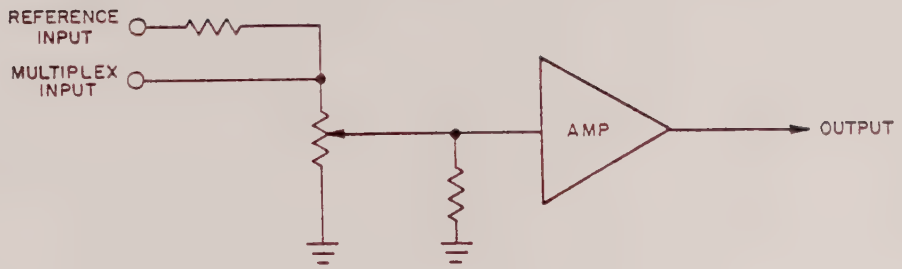


Table 1 Transistor Voltage Measurements for VCO and Reference Oscillator

TRANSISTOR	EMITTER	BASE	COLLECTOR
Q1	+0.5 V	----	+3.5 V
Q2	+0.5 V	----	+3.5 V
Q3	+1.0 V	+1.6 V	+5.4 V
Q4	0.0 V	+0.5 V	+7.0 V
Q5	0.0 V	+0.5 V	+7.0 V

NOTES:

1. Use oscilloscope for voltage measurements.
2. Values listed are average DC voltages of the observed waveforms.

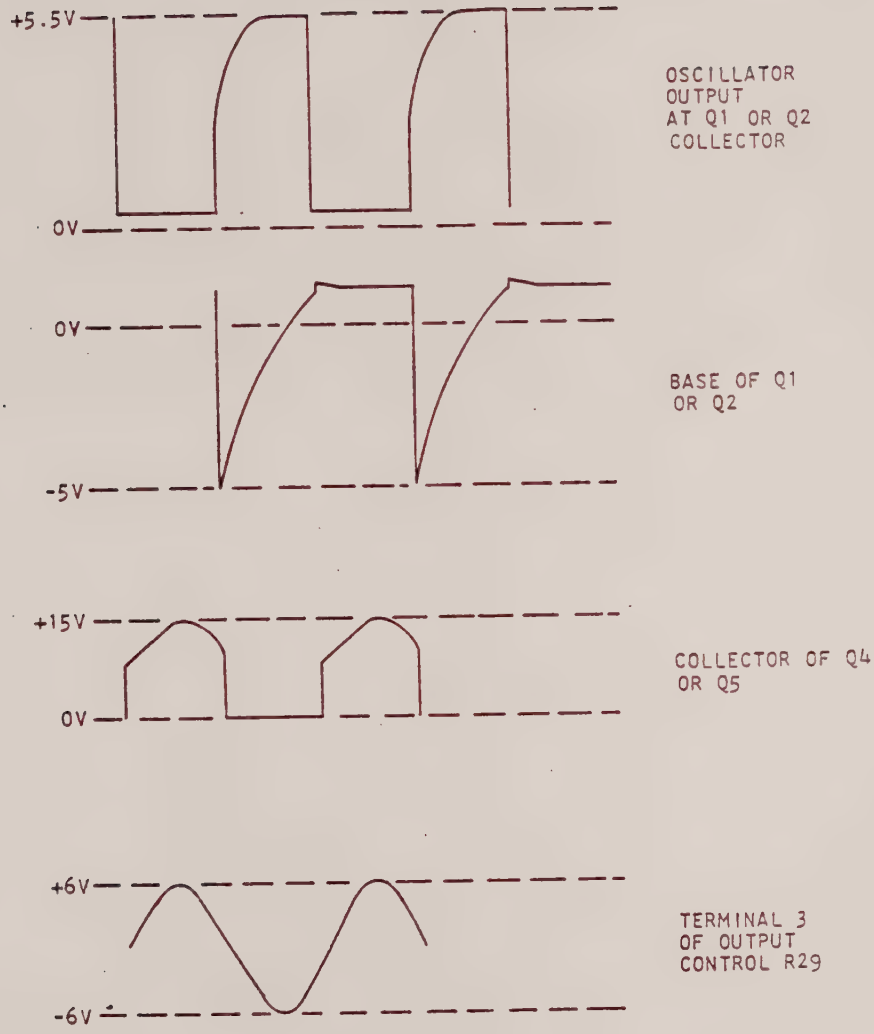


Figure 3 Typical Waveforms for VCO and Reference Oscillator

In all cases, the voltage measurements should be taken with an oscilloscope. This eliminates loading of the circuits which may, otherwise, result in erroneous readings. Notes on the transistor voltage table indicate conditions which must be observed when measuring voltage levels.

8. PARTS LIST

A complete listing of all components on the EMR 645-02 and 645-03 is contained in Table 2. Similarly, a listing of all components on the 645-04 is contained in Table 3. This table lists all components by ITEM NO. (reference designation). The total quantity of a component on the card is provided in the QTY. REQ'D. column. Each part is assigned an EMR stock number as listed in the EMR NUMBER column. When a component is manufactured by EMR or is purchased through an EMR specification, the EMR assigned number is provided in the DRAWING or SPEC NO. column. A complete component description is provided in the DESCRIPTION column.

Table 2 EMR 645-02 and 645-03 Parts List (Sheet 1 of 3)

PARTS LIST 29929 REV DATE 02/17/77 REV LTR C
LIST TITLE PWA,REF VCO,LINE DRIVER CHGE CONT NO. CODE IDENT SHT 1 OF 3
PART NO. 205-89-01680 ECO 54498 06141 CKD BY D. Sander

ITEM NO.	QTY REQD	E M R NUMBER	DRAWING OR SPEC NO.	DESCRIPTION
1	1	204-99-01112	29928	PWB,REF VCO,LINE DRIVER
2	4	421-98-00001		INSERT,THREADED,4-40NC-2
3	4	229-02-00074		SCREW,4-40X5/16 PAN HD
4	1	232-99-00071	23026	SHIELD,PWB,GROUND
5	2	298-98-00008		HTSK,FOR TO-5 PKG
6	5	189-98-00004		PAD,XSTR 4 PIN*USE OPTL*
7	4	189-99-00005	800-3	PAD,XSTR 8 PIN*USE OPTL*
8	AR	276-02-00004		WIRE,#28,SOL, WHT, 600V
9	AR	276-99-00009	619-24	WIRE,#24,BUSS,SOLID
10	AR	268-02-00058		TUBING,#24,EXTR TEF,WHT
C 1	1	337-13-15004	601	CAP., 15MF 10% 20V
C 3	1	999-01-00006	14902	CAP,*POA VAR*
C 4	1	999-01-00007	14902	CAP,*POA VAR*
C 5	1	304-62-10000	600	CAP. 1000PF 1% 100V
C 6	1	304-01-01509	600	CAP. 15PF .5PF 500V
C 7	1	304-01-01509	600	CAP. 15PF .5PF 500V
C 8	1	999-01-00003	14902	CAP,*POA VAR*
C 9	1	999-01-00001	14902	CAP,*POA VAR*
C 10	1	999-01-00002	14902	CAP,*POA VAR*
C 11	1	301-13-10002		CAP, .1UF 20% 50V LS.200
C 13	1	301-13-10002		CAP, .1UF 20% 50V LS.200
C 14	1	336-13-22003	601	CAP. 2.2MF 10% 20V
C 15	1	336-13-22003	601	CAP. 2.2MF 10% 20V
C 16	1	301-13-10002		CAP, .1UF 20% 50V LS.200
C 18	1	301-13-10002		CAP, .1UF 20% 50V LS.200
C 19	1	336-13-22003	601	CAP. 2.2MF 10% 20V
C 20	1	336-13-22003	601	CAP. 2.2MF 10% 20V
CR 1	1	088-10-09360		DIODE,REF,9V/7.5MA,.005 %
CR 2 THRU CR 4	3	088-10-41480		DIODE,SW,75V/5UA,4NS/10MA
CR 5	1	999-01-00001	29929	DIODE, *POA VAR*
CR 6	1	999-01-00002	29929	DIODE, *POA VAR*
K 1	1	999-01-00003	29929	RELAY, *POA VAR*
Q 1	1	263-47-00049		XSTR,NPN SW,HS, 60NA IBL
Q 2	1	263-47-00049		XSTR,NPN SW,HS, 60NA IBL
Q 3	1	~~263-10-39470~~ *263-10-39120		*XSTR,NPN 40V SW-RMPL HFE
Q 4	1	263-10-36460		XSTR,NPN 40V,300MA SW,ON
Q 5	1	263-10-36460		XSTR,NPN 40V,300MA SW,ON
R 1	1	616-02-30009		RES. 300 OHM 5% 1/4W

Table 2 EMR 645-02 and 645-03 Parts List (Sheet 2 of 3)

ITEM NO.	QTY REQD	E M R NUMBER	DRAWING OR SPEC NO.	DESCRIPTION
R 2	1	616-02-15009		RES,150 OHM 5% 1/4W
R 3	1	608-09-10000	624	RES. 1K 1% 1/10W
R 4	1	201-98-00105		POT,TRMR, 20 K 10%.75W
R 5	1	608-09-10001	624	RES. 10K 1% 1/10W
R 6	1	608-09-10001	624	RES. 10K 1% 1/10W
R 7	1	608-09-15001	624	RES, 15.0K 1% 1/10W
R 8	1	608-09-33209	624	RES, 332.0 OHM 1% 1/10W
R 9 THRU R 14	6	608-09-20002	624	RES, 200.0K 1% 1/10W
R 15	1	201-98-00109		POT,TRMR,500 K 10%.75W
R 16	1	608-09-68100	624	RES. 6.81K 1% 1/10W
R 17	1	608-09-18700	624	RES, 1.87K 1% 1/10W
R 18	1	608-09-53600	624	RES, 5.36K 1% 1/10W
R 19	1	608-09-13700	624	RES. 1.37K OHM 1% 1/10W
R 20	1	608-09-68100	624	RES. 6.81K 1% 1/10W
R 21	1	201-98-00033		POT,TRMR,5.0 K 10% 1W
R 22	1	201-98-00033		POT,TRMR,5.0 K 10% 1W
R 23	1	616-02-22002		RES,220K 5% 1/4W
R 24	1	616-02-22002		RES,220K 5% 1/4W
R 25	1	999-01-00008	14902	RES,*FVAR*
R 26	1	999-01-00009	14902	RES,*FVAR*
R 27	1	608-09-47501	624	RES, 47.5K 1% 1/10W
R 28	1	608-09-47501	624	RES, 47.5K 1% 1/10W
R 29	1	201-98-00105		POT,TRMR, 20 K 10%.75W
R 30	1	616-02-47001		RES,47K 5% 1/4W
R 31	1	616-02-43001		RES,43K 5% 1/4W
R 32	1	608-09-17400	624	RES, 1.74K 1% 1/10W
R 33	1	608-09-10001	624	RES. 10K 1% 1/10W
R 34	1	616-02-47001		RES,47K 5% 1/4W
R 35	1	201-98-00301		POT,TRMR, 50 K 10% .75W
R 36	1	622-02-04709		RES, 47 OHM 5% 1/2W
R 37	1	616-02-10009		RES,100 OHM 5% 1/4W
R 38	1	616-02-30000		RES,3K 5% 1/4W
R 39	1	616-02-15009		RES,150 OHM 5% 1/4W
R 40	1	622-02-04709		RES, 47 OHM 5% 1/2W
R 41	1	622-02-05109		RES, 51 OHM 5% 1/2W
R 42	1	616-02-47001		RES,47K 5% 1/4W
R 43	1	201-98-00301		POT,TRMR, 50 K 10% .75W
R 44	1	622-02-04709		RES, 47 OHM 5% 1/2W
R 45	1	616-02-10009		RES,100 OHM 5% 1/4W
R 46	1	616-02-30000		RES,3K 5% 1/4W
R 47	1	616-02-15009		RES,150 OHM 5% 1/4W
R 48	1	622-02-04709		RES, 47 OHM 5% 1/2W

Table 2 EMR 645-02 and 645-03 Parts List (Sheet 3 of 3)

205-89-01680 29929 SHT 3 OF 3

ITEM NO.	QTY REQD	E M R NUMBER	DRAWING OR SPEC NO.	DESCRIPTION
R 49	1	622-02-05109		RES, 51 OHM 5% 1/2W
R 52	1	999-01-00004	29929	RES, *POA VAR*
R 53	1	999-01-00005	29929	RES, *POA VAR*
TP 1	1	143-98-00051		JACK,TEST PT,PW TYPE,RED
TP 2	1	143-98-00005		JACK,TEST,BLACK
TP 3	1	143-98-00051		JACK,TEST PT,PW TYPE,RED
TP 4	1	143-98-00005		JACK,TEST,BLACK
TP 5	1	143-98-00051		JACK,TEST PT,PW TYPE,RED
TP 6	1	143-98-00014		JACK,TEST PT,PW TYPE,BLU
TP 7	1	143-98-00015		JACK,TEST PT,PW TYPE,VIO
U 1	1	046-45-00003		IC,LIN AMPL,OPNL HS SLEW
U 2	1	046-34-00022		IC,LIN AMPL,CUR DC/30MHZ
U 3	1	046-45-00003		IC,LIN AMPL,OPNL HS SLEW
U 4	1	046-34-00022		IC,LIN AMPL,CUR DC/30MHZ
REF 1	1	905-01-01407	29927	SCHEM,PWA,VCO,LINE DRVR
REF 2	1	905-05-00302	14902	VARIABLE CHART,REF OSC
REF 3	1	905-04-00001	9500	SPEC,COMPONENT SPACING

Table 3 EMR 645-04 Parts List (Sheet 1 of 2)

E M R - T E L E M E T R Y

PART NBR 29928-1 REV DATE 02/17/77 REV LTR B
LIST TITLE PWA,DUAL LINE DRIVER CHGE CONT NO. CODE IDENT SHT 1 OF 2
PART NO. 205-99-01169 ECO 54498 06141 CKD BY D. Sanders

ITEM NO.	QTY REQD	EMR NUMBER	DRAWING OR SPEC NO.	DESCRIPTION
1	1	204-99-01112	29928	PWB,REF VCC,LINE DRIVER
2	4	421-98-00001		INSERT,THREADED,4-40NC-2
3	4	229-02-00074		SCREW,4-40X5/16 PAN HD
4	1	232-99-00071	23026	SHIELD,PWB,GROUND
5	2	298-98-00008		HTSK,FOR TO-5 PKG
7	4	189-99-00005	800-3	PAD,XSTR 8 PIN#USE OPTL*
9	AR	276-99-00009	619-24	WIRE,#24,CUSS,SOLID
10	AR	268-02-00058		TUBING,#24,EXTR TEF,WHT
C 11	1	301-13-10002		CAP, .1UF 20% 50V LS.200
C 13	1	301-13-10002		CAP, .1UF 20% 50V LS.200
C 14	1	336-13-22003	601	CAP. 2.2MF 10% 20V
C 15	1	336-13-22003	601	CAP. 2.2MF 10% 20V
C 16	1	301-13-10002		CAP, .1UF 20% 50V LS.200
C 18	1	301-13-10002		CAP, .1UF 20% 50V LS.200
C 19	1	336-13-22003	601	CAP. 2.2MF 10% 20V
C 20	1	336-13-22003	601	CAP. 2.2MF 10% 20V
R 34	1	616-02-47001		RES,47K 5% 1/4W
R 35	1	201-98-00301		POT,TRMR, 50 K 10% .75W
R 36	1	622-02-04709		RES, 47 OHM 5% 1/2W
R 37	1	616-02-10009		RES,100 OHM 5% 1/4W
R 38	1	616-02-30000		RES,3K 5% 1/4W
R 39	1	616-02-15009		RES,150 OHM 5% 1/4W
R 40	1	622-02-04709		RES, 47 OHM 5% 1/2W
R 41	1	622-02-05109		RES, 51 OHM 5% 1/2W
R 42	1	616-02-47001		RES,47K 5% 1/4W
R 43	1	201-98-00301		POT,TRMR, 50 K 10% .75W
R 44	1	622-02-04709		RES, 47 OHM 5% 1/2W
R 45	1	616-02-10009		RES,100 OHM 5% 1/4W
R 46	1	616-02-30000		RES,3K 5% 1/4W
R 47	1	616-02-15009		RES,150 OHM 5% 1/4W
R 48	1	622-02-04709		RES, 47 OHM 5% 1/2W
R 49	1	622-02-05109		RES, 51 OHM 5% 1/2W
TP 3	1	143-98-00051		JACK,TEST PT,PW TYPE,RED

Table 3 EMR 645-04 Parts List (Sheet 2 of 2)

TP 4	1	143-98-00005		JACK,TEST,BLACK
TP 5	1	143-98-00051		JACK,TEST PT,PW TYPE,RED
U 1	1	046-45-00003		IC,LIN AMPL,OPNL HS SLEW
U 2	1	046-34-00022		IC,LIN AMPL,CUR DC/30MHZ
U 3	1	046-45-00003		IC,LIN AMPL,OPNL HS SLEW
U 4	1	046-34-00022		IC,LIN AMPL-CUR DC/30MHZ
REF 1	1	905-01-01407	29927	SCHEM,PWA,VCO,LINE DRVR
NO.	REQD	NUMBER	SPEC NO.	
REF 2	1	905-04-00001	9500	SPEC,COMPONENT SPACING

MP MASTER
MA20089